Problem 1:

A temperature control system operates by sensing the difference between the thermostat setting and the actual temperature and then 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.
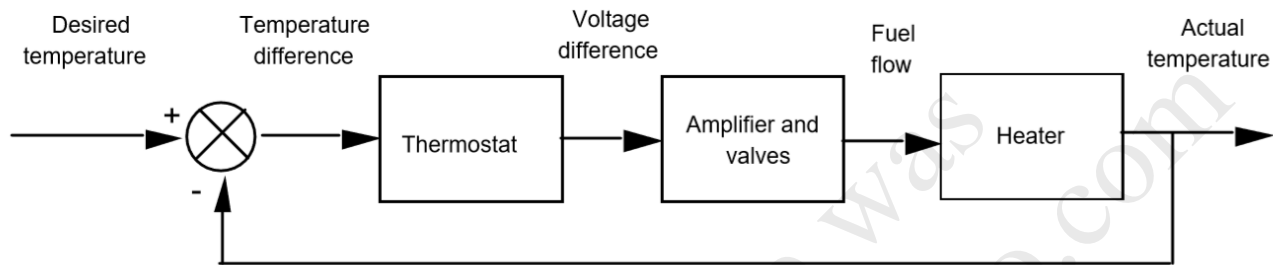
Solution:

Assignment 1. Problem 1.

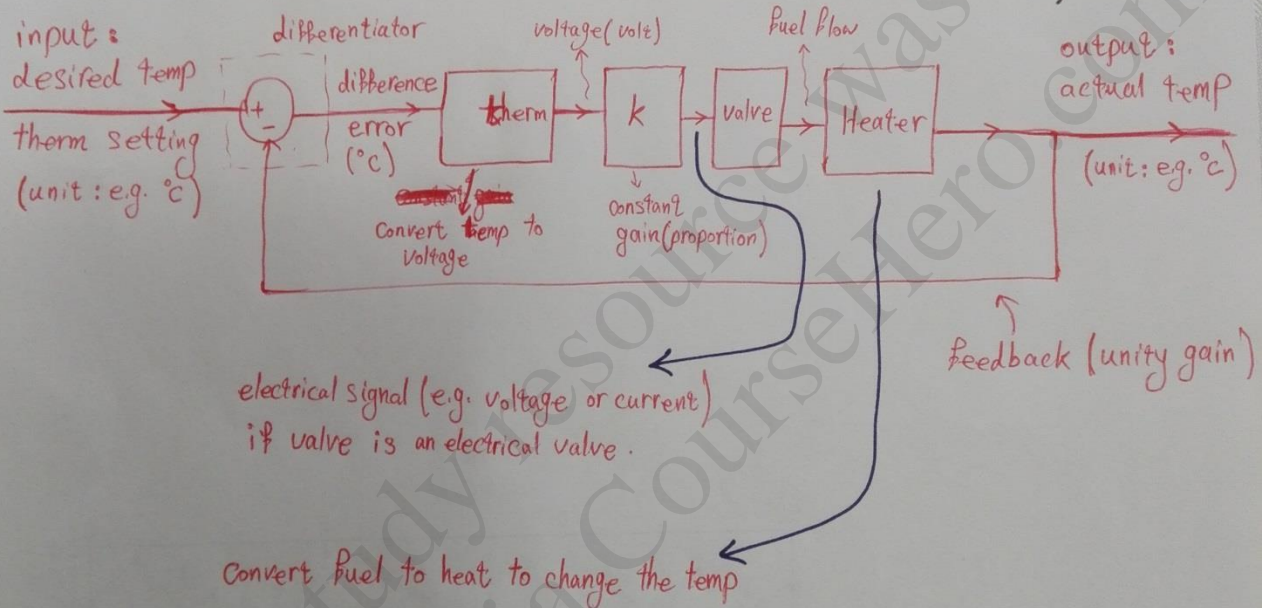Pay attention to the underlined words of the problem statement.

thermostat setting : this is the desired temperature which is the input.

actual temperature : is the output of the system.

difference : we need an part to take the difference. →⊕

Valve : we need a valve in system.

proportional : we need a constant gain block before the valve to provide valve with an input proportional to temperature error (difference).

input :
desired temp
therm setting
(unit : e.g. °C)

differentiator

difference
error
(°C)

Convert temp to Voltage

voltage (volt)

therm

k

Constant gain (proportion)

Valve

fuel flow

Heater

output :
actual temp

(unit : e.g. °C)

feedback (unity gain)

electrical signal (e.g. voltage or current)
if valve is an electrical valve.

Convert fuel to heat to change the temp

k : Controller

Valve + Heater : plant (valve can be considered as a part of controller)

Thermostat + differentiator : transducer

Problem 2:

During a medical operation an anesthesiologist controls the depth of unconsciousness by controlling the concentration of isoflurane in a vaporized mixture with oxygen and nitrous oxide. The depth of anesthesia is measured by the patient's blood pressure. The anesthesiologist also regulates ventilation, fluid balance, and the administration of other drugs. In order to free the anesthesiologist to devote more time to the latter tasks, and in the interest of the patient's safety, we wish to automate the depth of anesthesia by automating the control of isoflurane concentration. Draw a functional block diagram of the system showing pertinent signals and subsystems.

Solution: