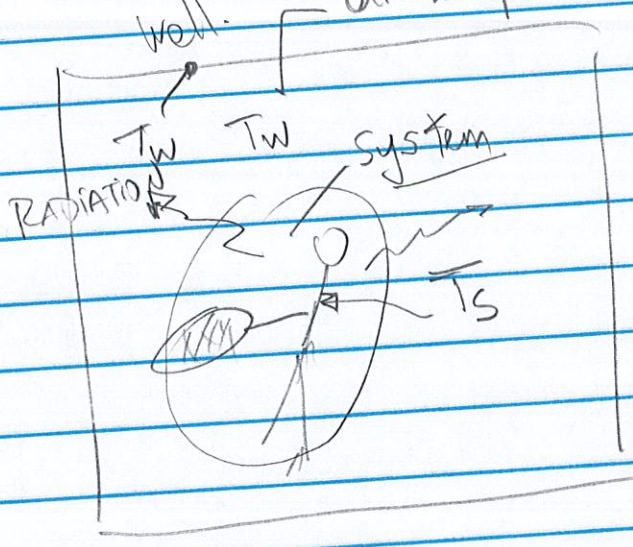
OFFICE HOURS 1/17/18

BALANCE OF ENERGY [FIRST LAW OF THERMODYNAMICS]

~~Energy~~ In − ENERGY OUT + Generation of Energy =

= 0 = STORAGE ~~OF~~ ENERGY — steady state.



$$P_s = 13.3\,l^{20.4 - 5132\,T_s}$$

$$f(T_s) = 0 = -\left\{ \underbrace{hA(T_s - T_w)}_{\text{Convection}} + \underbrace{\sigma A\left[T_s^4 - T_w^4\right]}_{\text{RADIATION PART}} + 0.12\,N^{0.5}\,A(P_s - P_\infty) \right\}$$

$+ 4\,mN$

STEFAN-BOLTZMAN CONSTANT

$5.67 \times 10^{-8}\ \frac{W}{K^4 m^2}$

RADIATION PART THE UNITS OF TEMPERATURE IS IMPORTANT AND THEY HAVE TO BE ABSOLUTE TEMPERATURES (K or R)

Generation of heat $= (4)\, m N$ (2)

m: kg, N: $\frac{m}{s}$

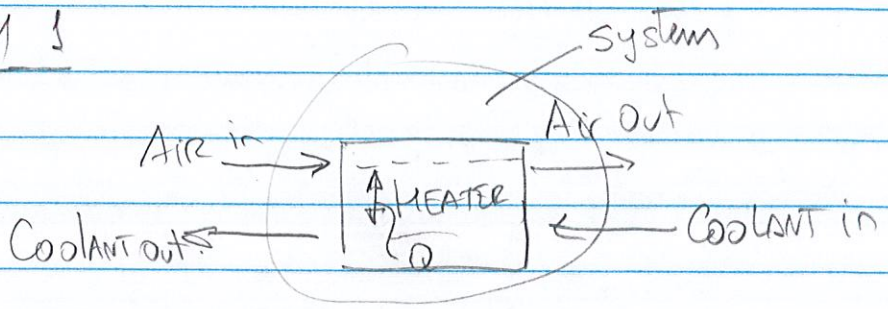
MATHCAD FUNCTION is ROOT (f (Ts)

MATLAB FUNCTION is ALSO ROOT

Excel GOAL SEEK

Ts	f(Ts)
—	—
—	—
—	
—	

PROBLEM 1



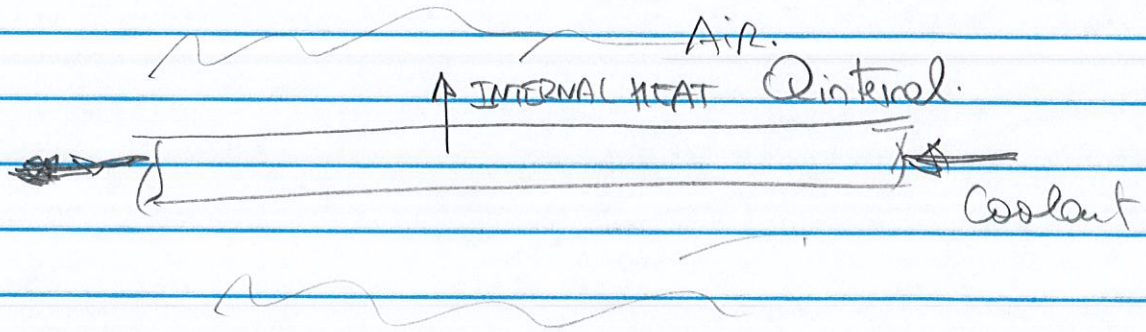
$$\frac{dE}{dt} = \sum \dot{m}_{in} h_{in} - \sum \dot{m}_{out} h_{out} + Q - W_{shaft}$$

For steady state

$$\sum \dot{m}_{in} h_{in} - \sum \dot{m}_{out} h_{out} + \cancel{Q} - \cancel{W_{shaft}} \quad (3)$$

We can assume heater does not heat $Q = 0$

if $Q = 0$ We don't care about the transfer of heat so it is a thermodynamic problem



Question 4

$$\frac{d^2T(x)}{dx^2} = -m^2 T(x)$$

$$\frac{d^2T}{dx^2} + m^2 T(x) = 0$$

Proposed solution $T(x) = \sin(mx) + \cos(mx)$

$$\frac{dT(x)}{dx} = m\cos(mx) - m\sin(mx)$$

$$\frac{d^2T}{dx^2} = -m^2\sin(mx) - m^2\cos(mx)$$

$$\frac{d^2T}{dx^2} = -m^2\left[\sin(mx) + \cos(mx)\right]$$

Substituting into the equation (4)

$$-m^2\left[\sin(mx)+\cos(mx)\right]+m^2\left[\sin(mx)+\cos(mx)\right]$$

$$=0$$

So $T(x)=\sin(mx)+\cos(mx)$ is one solution.