VENTILATOR

TEST CASE (HEAT EXCHANGER)

Document name: R170720_01

Prepare by:- PRANAV REDDY

OBJECTIVE

To observe the functioning of the passive heat exchanger by taking note of test cases with respect to change in its sole control parameter, the surface area.

SCHEMATIC

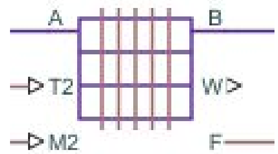


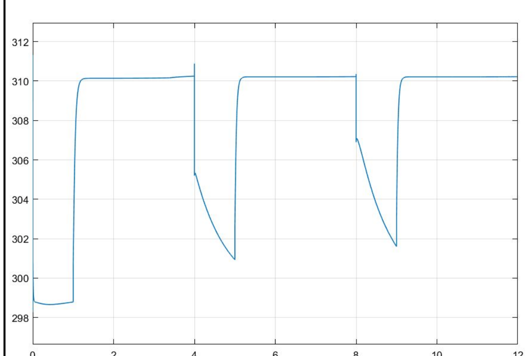
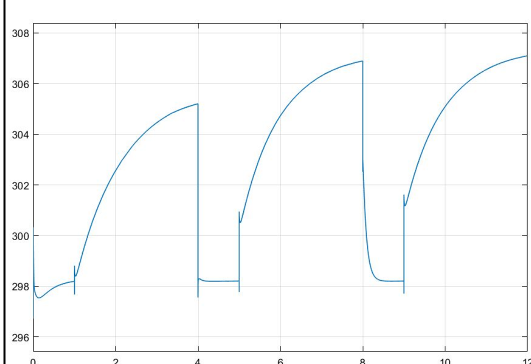
Fig 1. Schematic of the passive heat exchanger block in simulink

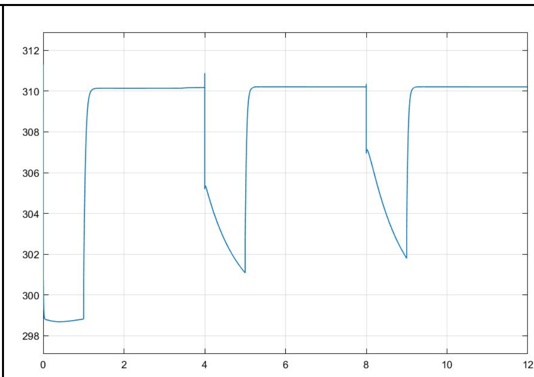
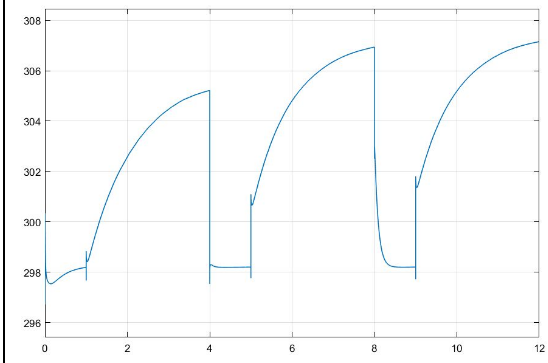
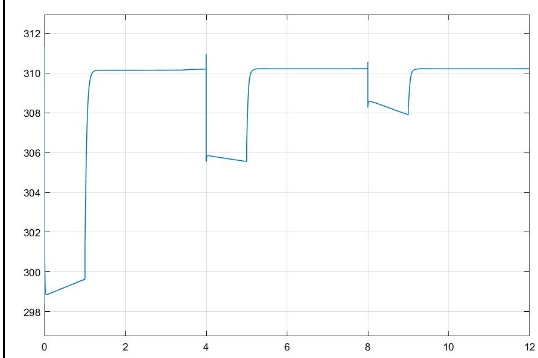
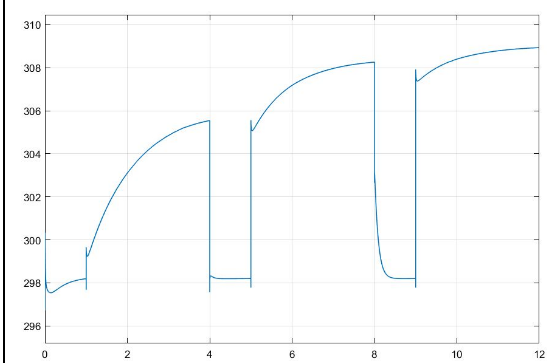
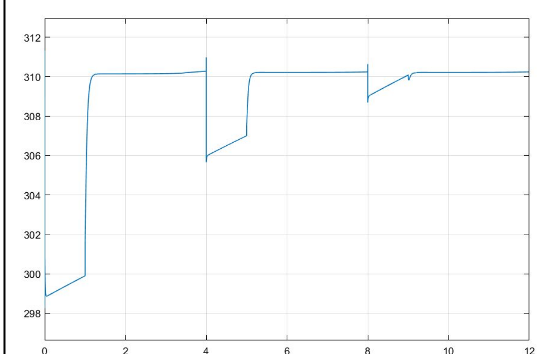
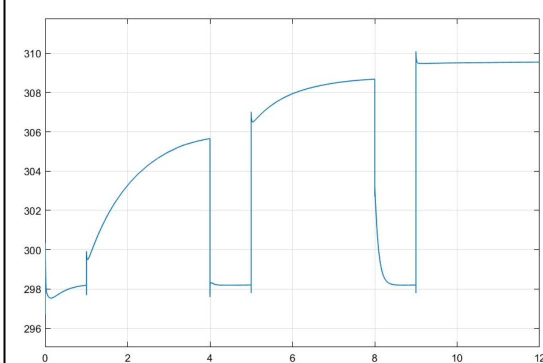
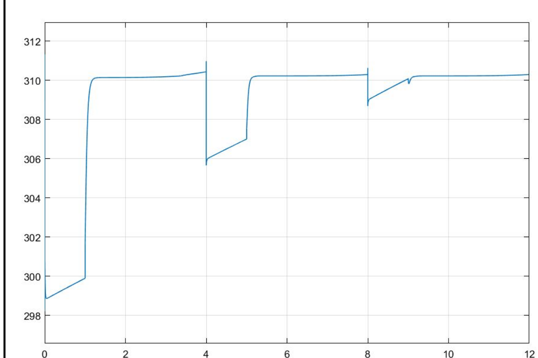
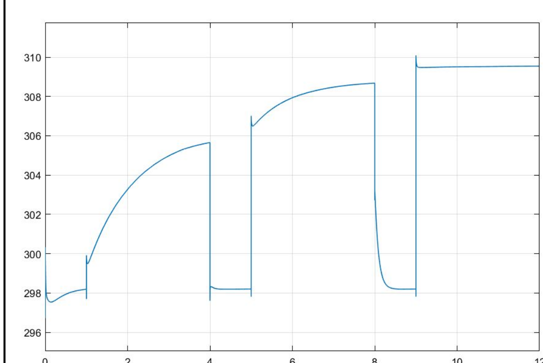
Ports A, B - Moist air conserving ports associated with the moist air inlet and outlet.
T2 [K] - Physical signal input for the temperature of the coolant (Exhaust air in our case)
M2 [kg/s] - Physical signal input for the mass flow rate of the coolant.
W [kg/s] - Physical signal port reporting the rate of condensation.
F - Physical signal port reporting moist air volume measurements.

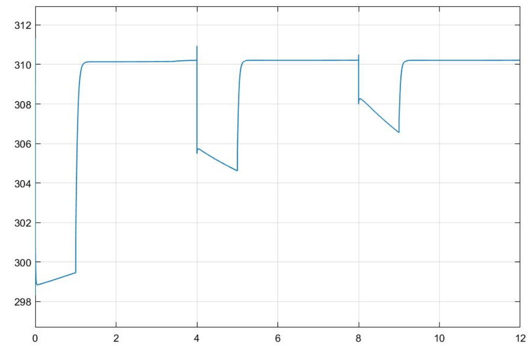
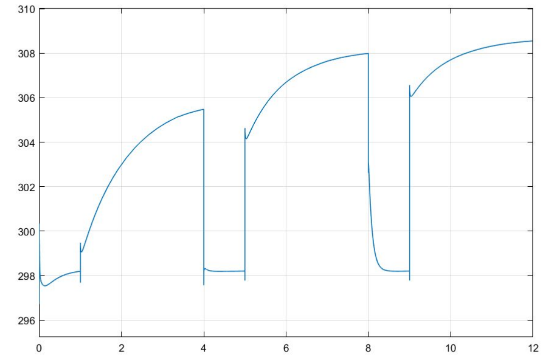
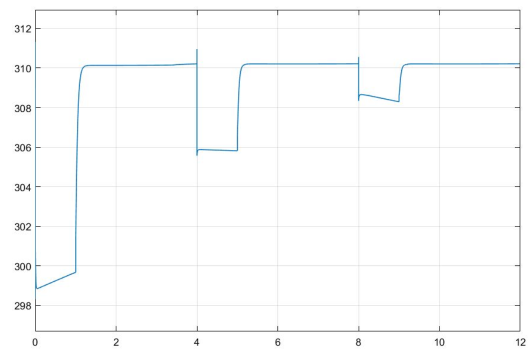
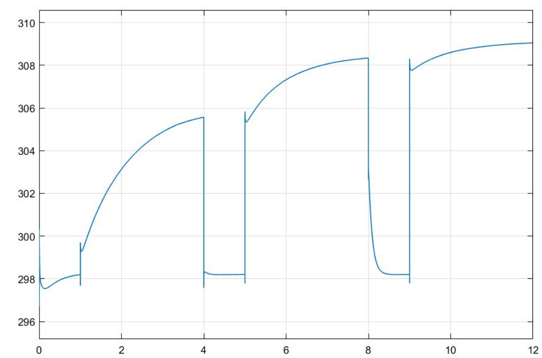
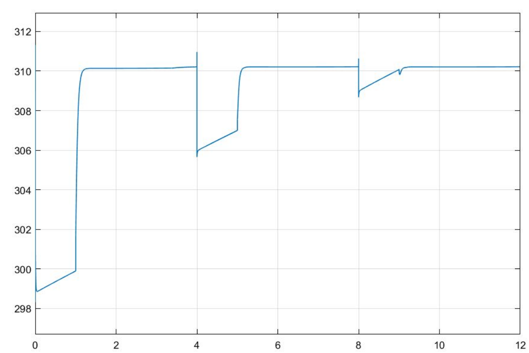
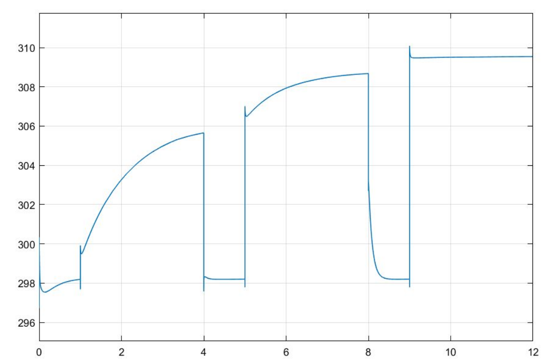
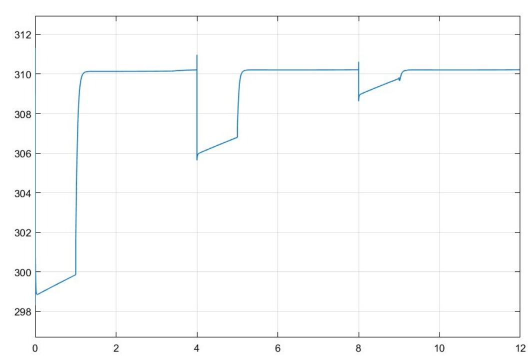
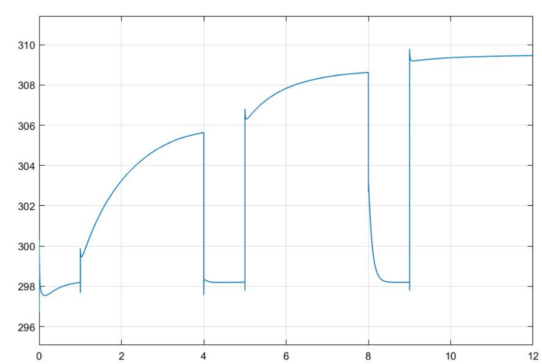
A heat retaining steel scrubber with high surface area could serve as the heat exchanger in our model.

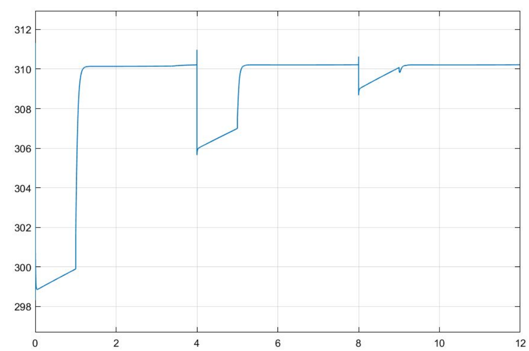
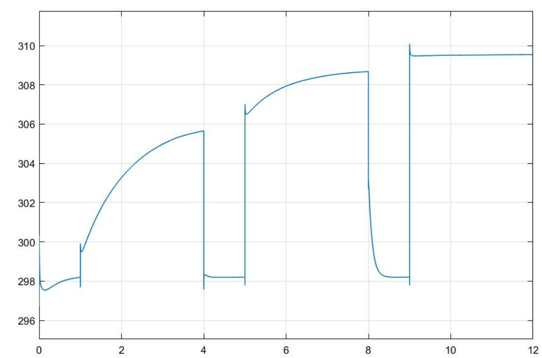
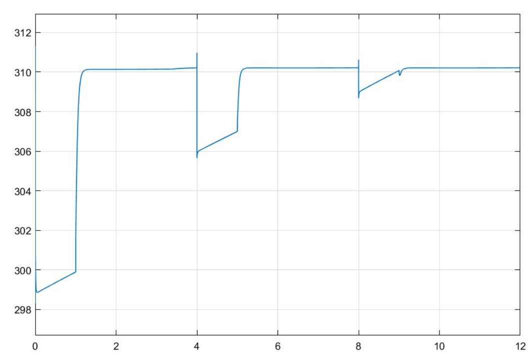
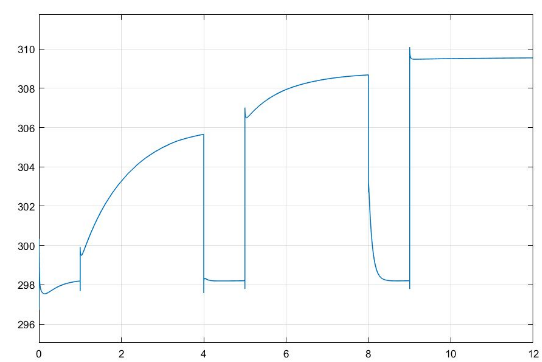
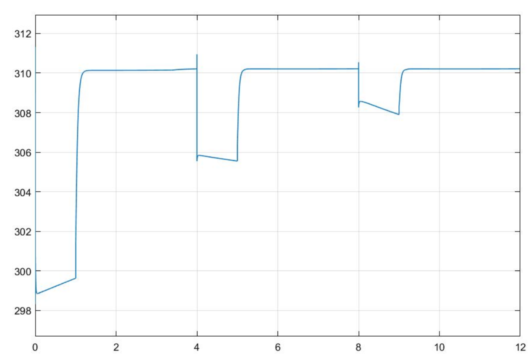
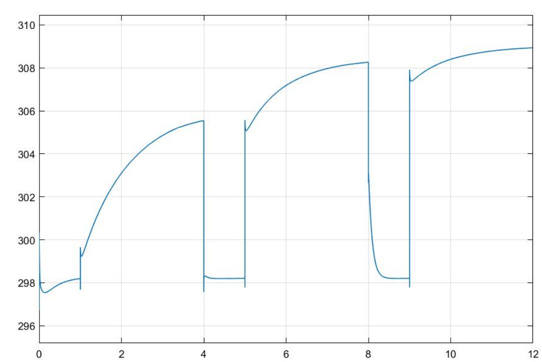
OBSERVATIONS

Inlet air mass flow rate = 2.2 kg/s
Exhaust air mass flow rate = 2.45 kg/s
Inlet air pressure drop = 4 kpa
Inlet air specific heat = 1.01 kJ / kg/ k
Exhaust air specific heat = 1.02 kJ / kg/ k

S. No	Control Parameters	EXHAUST AIR TEMP PROFILE	INLET AIR TEMP PROFILE
1)	Ti = 35 ^{0}C Te = 41 ^{0}C Surface Area = 1 cm^2		

2	Ti = 35 ^{0}C Te = 41 ^{0}C Surface Area = 20 cm^2		
3	Ti = 35 ^{0}C Te = 41 ^{0}C Surface Area = 500 cm^2		
4	Ti = 35 ^{0}C Te = 41 ^{0}C Surface Area = 2500 cm^2		
5	Ti = 35 ^{0}C Te = 41 ^{0}C Surface Area = 7500 cm^2		

		BY VARYING INPUT AIR TEMPERATURE	
6	Ti = 25 ^{0}C Te = 41 ^{0}C Surface Area = 1000 cm^2		
7	Ti = 30 ^{0}C Te = 41 ^{0}C Surface Area = 1000 cm^2		
8	Ti = 40.9 ^{0}C Te = 41 ^{0}C Surface Area = 1000 cm^2		
9	Ti = 48 ^{0}C Te = 41 ^{0}C Surface Area = 1000 cm^2		

		BY VARYING EXHALED AIR TEMPERATURE	
10	Ti = 36 ^{0}C Te = 33 ^{0}C Surface Area = 1000 cm^2		
11	Ti = 36 ^{0}C Te = 40^{0}C Surface Area = 1000 cm^2		
12	Ti = 36 ^{0}C Te = 48^{0}C Surface Area = 1000 cm^2		

CONCLUSIONS

The passive heat exchanger model works well on our system and helps it to attain the ideal temperature range (around 37-37.5 deg celsius - Normal human temperature) in about 3 breathing cycles, even under adverse temperature conditions.
Ideal conditions should resist sudden temperature fluctuations (spikes in the graph) and should limit the temperature profile to a very low range to avoid lung damage.
Ideal surface area that would be required from the heat retaining scrubber falls in the range 780- 2000 cm^2. All the other parameters have been chosen according to standard parameters