Experiment 9 : First order and Second order system

9.1

Title : Study of step response of thermometer

Aim : To study the response of thermometer for step change

Procedure:

- The heating bath was filled with clean water by opening the inlet valve.
- The beeper was switched on and the timer was set to 3 seconds interval.
- The heater was switched on to heat the water bath to nearly its boiling point and the heater was then switched off.
- The thermometer was brought to room temperature and inserted in the bath as soon as the heater was switched off.
- The readings of the thermometer was noted till the temperature attended a steady state.

9.2

Aim : To study the response of thermowell for step change

Procedure : It was the same as in 9.1, only the thermometer was replaced by a thermowell.

9.3

Title : Study of sinusoidal response of a thermowell

Aim : To study the response of a thermowell for a sinusoidal singal.

Procedure:

- Inlet valve of heating bath was opened and water was supplied to it a constant rate.
- The thermometer was inserted in the inlet and the thermowell was inserted in the outlet of the water bath.
- The cyclic timer was set to 30seconds on-off time for the heater.
- A sinusoidal pattern was observed by taking the thermometer and thermowell readings after steady state was reached.
- The amplitude could be controlled by the water flow rate or the on-off time.

9.4

Aim : To study the response of mercury manometer for a step change

Procedure :

- The mercury level of the manometer was set to 0 on the scale.
- The blower was switched on and the needle valve and the outlet vent were adjusted to raise the mercury level till about 200mm.
- The vent was released and the pattern of the mercury height was noted down.
- The time of oscillation was also noted down.
- The process was repeated for different step changes.

Manometer data :

- Manometer fluid : mercury
- Dynamic viscosity= 0.0016 kg/ms
- Mass density=13550 kg/m^3
- Column length=760mm
- Tube diameter=0.005m

9.5

Aim : To study the response of a water manometer for a step change

Procedure: Same as 9.4, only the manometer is different.

Manometer data :

- Manometer fluid : water
- Dynamic viscosity= 0.001 kg/ms
- Mass density=993 kg/m^3
- Column length= 1.050m
- Tube diameter= 0.022m

Discussions:

- The main sources of error in this experiment were human error while taking the readings and setting the beeper to exact 3 seconds.
- The water flow might not be constant.
- The on-off cycle wasn't exactly 30 seconds.
- From the results we can see that the response of the thermometer was faster than the thermowell because the well adds to some resistance in the heat flow.
- The sinusoidal wave was very accurately observed.
- The manometer readings were too fast and had to be video simulated.