**Transfer function:-**

It is the transfer function that is revealed by the mathematical model, and it is these words that define the process reaction that are revealed: gain, Time Constant, and Dead Time. The fluid that runs through the inner pipe at a constant velocity (v) is heated by steam condensing outside the pipe in the heat exchanger. The metal wall that separates the steam from the fluid is believed to have substantial thermal capacity, which must be taken into consideration throughout the study. The heat transfer coefficient on the steam side (ho) and the convective transfer coefficient on the water side (ct) determine the amount of heat transferred from the steam to the fluid (hi). The resistance of the metal wall is not taken into consideration. To do this, the transfer functions linking the departing fluid temperature T (L,t) to the entering fluid temperature T (0,t) and the steam temperature Tv must be identified and determined (t).

It is assumed that the heat exchanger transfer function GP(s) is linearly related to outlet temperature the steam flow ( and that the time constant is 30 seconds.

“The pneumatic control valve is the last control element that is utilized the most frequently. In this situation, an equal percentage valve and an air to shut type pneumatic are utilised. This is defined by the balance of all forces operating on it, which results in the stem's location. The balance of all forces determines the position of the stem, the forces are force exerted by the compressed air at the top of the diaphragm represented by (Pd A), another force is which is responsible due to the force exerted by the spring attached to the stem and the diaphragm(Kx), and lastly the frictional force exerted upwards().”

Second order system is assumed for the approximation of the dynamics of pneumatic valve as :-

For the above equation

Taking Pd = 20 psi, x = 15mm, diameter of the diaphragm = 270mm

At steady state K = = 126.74 psi/mm

For control valve transfer function, the control value has a maximum travel of 20mm, linear characteristic and time constant of 3 sec with a nominal pressure range is 7 to 160 psi.

Control value gain(

Transfer function

For the thermocouple selected can withstand temperature of -200℃ to 600℃, the calibrate range is assumed to be form 00 to 2000 and the time constant of 1 to 10 sec.

Sensor gain() = = 0.16

Transfer function H(s) = =

For the temperature control loop mentioned in the block diagram the overall closed loop transfer function will be