AIM:

To obtain the closed loop response of flow control loop for servo and regulator Operation.

EQUIPMENT:

1. Flow process station with all accessories - 1 No
2. 2. Analog / Digital PID controller - 1 No
3. 3. Recorder - 1 No

THEORY:

Flow process controller is used to perform the control action on flow process. A Differential pressure transmitter is used to measure the flow of the fluid through orifice plate. Pump discharges the water from reservoir tank and give it to control valve. Computer acts as an error detector and controller. According to the error signal, that it develops a control signal.

This control signal is given to I/P Converter that operates the control valve. It controls the flow of the fluid in pipeline by varying stem position of the control valve. By pass line is provided to avoid the pump overloading. Data Acquisition card(Data Acquisition System) having ADC and DAC, section so that it acts an effective link between the process plant and the controller.

The level sensing element is a metal probe which is inserted vertically into the medium from the top of the tank. If the tank is a conductor it is used as a ground reference. In insulated tanks the probe is enclosed by a concentric electrode to serve as capacitance change.

When the tank is empty, the probe and inner wall of the tank are separated by air space. As the level of the medium increases the capacitance between the insulated probe and the tank wall increases. The change in capacitance is sensed and converted into a current signal in the range of 4-20 mA for transmission.

The I/P convertor is also called the electro pneumatic convertor, is used where a4 to 20 mA signal current is to be converted to 3-15 psi pressure signal. Essentially the convertor needs two inputs, viz. a fixed 20 psi air at its air inlet and a variable 4 to 20mA at its current input.

It consists of 3 basic parts:

- Pick up system
- Convertor
- Pneumatic relay

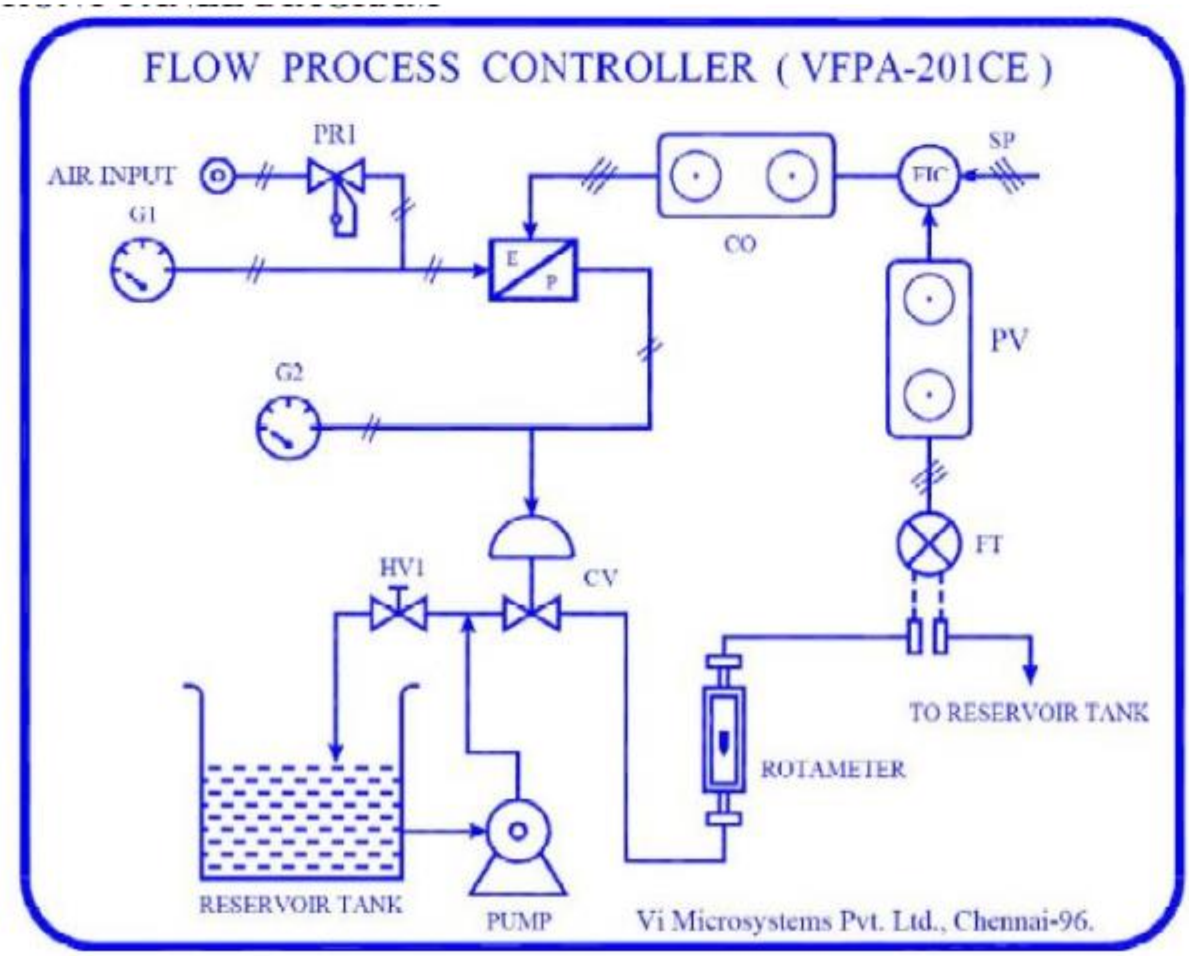
The pickup system consists of a voice coil situated in the air gap of permanent magnet. The convertor consists of a nozzle, the restrictor and the baffle plate on the beam, which is mounted on low friction fulcrum. The pneumatic relay consists of a diaphragm, a valve seat, a needle, and a capillary tube.

EXERCISE:

1 Closed – loop connection is made in the flow process station.

PROCESS DESCRIPTION: The block diagram and schematic diagram for Closed – loop connection is made in the flow process station as shown in fig. given below.

FRONT PANEL DIAGRAM



FRONT PANEL DESCRIPTION

Power ON/OFF Switch - It is used to switch ON/OFF the unit. Pump Speed regulator - It is used to vary the speed of the pump. G1 - It is used to indicate output pressure of air regulator. G2 - It is used to indicate the I/P converter output. PV - Test points for flow transmitter output (4- 20mA). CO - Test points for Controller output (4-20mA)

EXERCISE: 2

The flow controller (P+I) is tuned using any one of the tuning techniques

PROCEDURE:

i. Ensure the availability of Air & Water.
ii. Interface the PC with process and Data Acquisition System.
iii. Maintain Gauge (G1) pressure at 20 Psi by using air regulator knob.
   iv. Position the Hand valve HV1 in partially open position.
iv. Patch CO & PV terminals through Patch chords.
v. Switch ON the Data Acquisition System with PC.
vi. vii. Invoke Process Control Software.
vii. viii. Using PI control mode to met the desired flow

EXERCISE: 3

The response of the control loop is obtained for changes in the set point.

PROCEDURE:

I Procedure for exercise-1 is repeated upto viii.
ii. By changing the various set point, the response for corresponding set point plotted.
PI Controller Set Point---------- Kp----- Ki--------

EXERCISE: 4

The response of the control loop is obtained for changes in the load variable.

PROCEDURE:

Procedure for exercise-1 is repeated up to viii. ii. By varying HV1 (Disturbance), the response for corresponding disturbance plotted.
PI Controller Set Point---------- Kp----- Ki--------

EXERCISE: 5

The Exercise 3 and 4 are repeated for different controller modes and settings.

RESULT: Thus the closed loop response of flow process for Servo and Regulator operation was obtained.

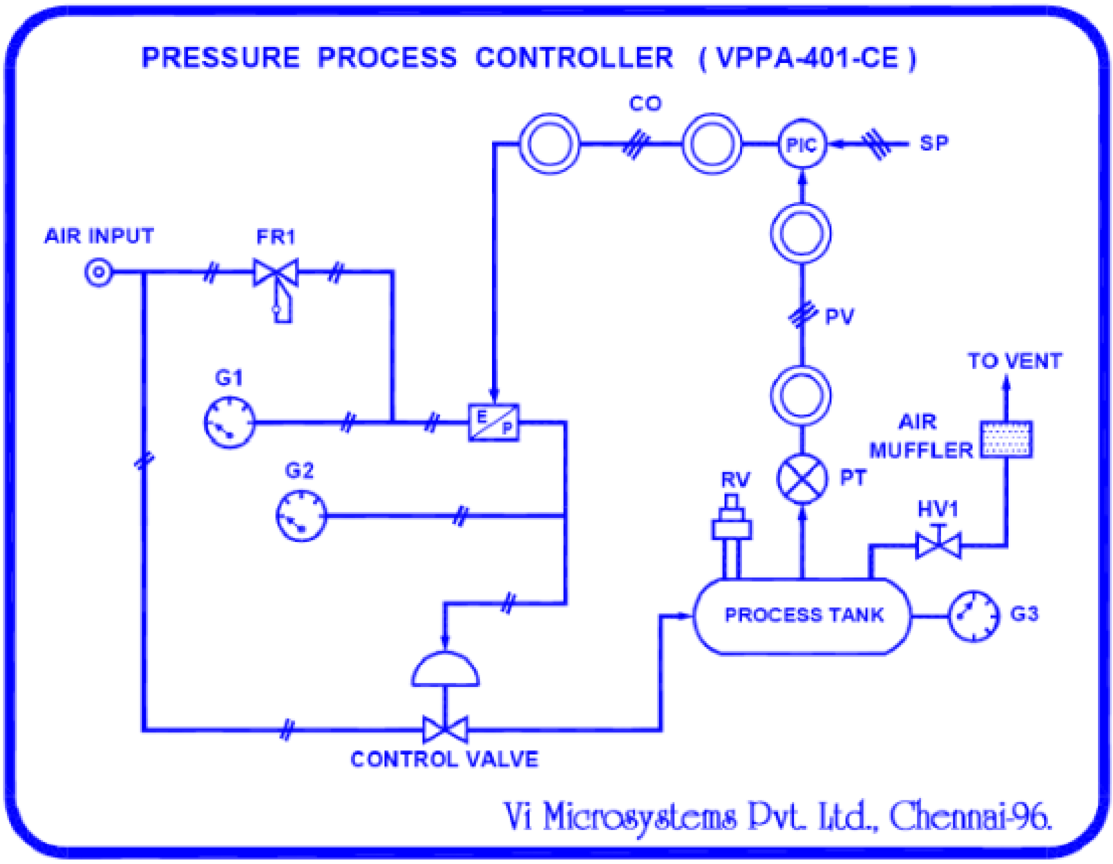
AIM

To obtain the closed loop response of pressure control loop for servo and regulator operation.

APPARATUS REQUIRED

1. Pressure Process Analyser. 2. Data Acquisition System. 3. PC with Process Control software. 4. Patch chords.
   THEORY EXERCISE:
   1 Closed loop connection is made in the pressure process station.

FRONT PANEL DIAGRAM



FRONT PANEL DESCRIPTION

Power ON/OFF Switch - It is used to switch ON/OFF the unit. Pump Speed regulator - It is used to vary the speed of the pump. G1 - It is used to indicate output pressure of air regulator. G2 - It is used to indicate the I/P converter output. PV - Test points for pressure transmitter output (4 - 20mA). CO - Test points for Controller output (4 - 20mA).

EXERCISE:

2 & 3 The level controller (P+I) is tuned using any one of the tuning techniques The response of the control loop is obtained for changes in the set

PROCEDURE * Ensure the availability of Air. * Interface the PC with process and Data Acquisition System. * Maintain Gauge (G1) pressure at 20 Psi by using air regulator knob. * Position the Hand valve HV1 in partially open position. * Patch CO & PV terminals through Patch chords. * Switch ON the Data Acquisition System with PC. * Invoke Process Control Software

Precautions:

1. Check the air inlet pressure to the process station as 100 – 150 psi. 2. Check whether the I/P converter inlet pressure is 20 psi. 3. Let hand valves HV2, HV4 and HV6 be fully closed position. 4. Keep the hand valves HV1 and HV3 connected tank 1 slightly opened. 5. Keep the outlet valve HV5 of tank 1 slightly opened. 6. Check whether there is any leakage in air path. 7. Switch off the mains before making the connections.

PI Controller Set Point---------- Kp----- Ki---------

RESULT

Thus the closed loop response of pressure process for Servo and Regulator operation was obtained

AIM

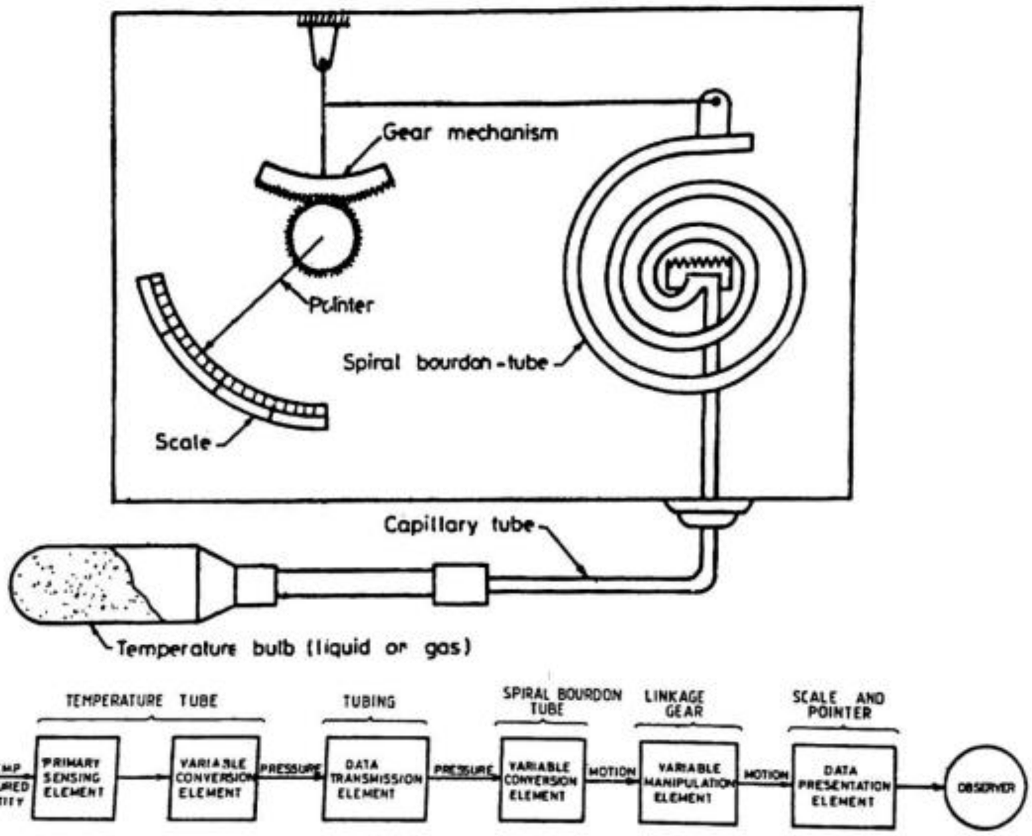
To obtain the operation of on-off controlled thermal process using filled in system thermometer.

APPARATUS REQUIRED

1. Temperature process set up

2. stop watch

EXPERIMENTAL SET UP



Filled-system thermometer

DESCRIPTION

The temperature is converted in to a mechanical motion caused by pressure or expansion, and this is measured. The instruments working with this principal are much simpler ones. The thermal system of a filled system thermometer

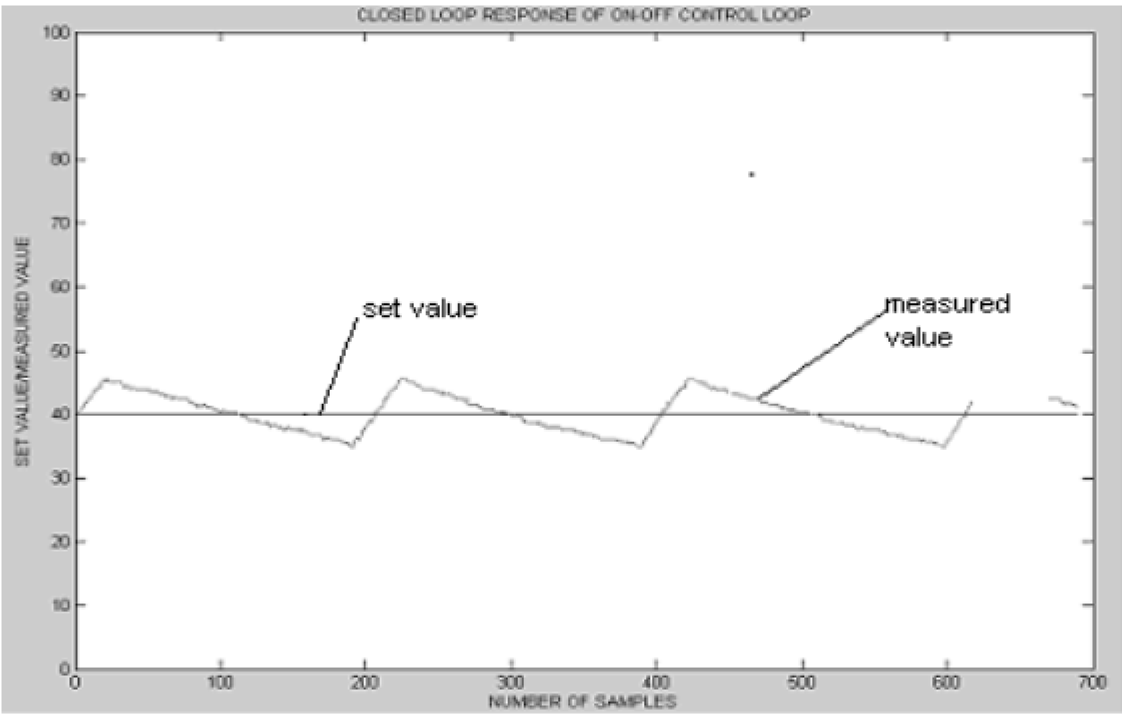
comprises the thermometer bulb, an expansion element, such as a Bourdon tube, diaphragm, capsule or bellows and a capillary tube connecting the bulb and the expansion element.

Study of on/off controller

PROCEDURE

Switch ON the trainer. 2. Adjust the required set temperature in standard temperature controller. 3. Put the sensors both the filled system thermometer temperature response bulb as well as standard temperature controller thermocouple in to the furnace. 4. The digital display of temperature controller shows the furnace temperature.The corresponding temperature is also displayed in the filled system thermometer temperature dial.

MODEL GRAPH



RESULT

Thus the operation of on-off controlled thermal process using filled in system thermometer was studied

AIM

To determine the dynamic characteristics of Proportional plus Integral plus Derivative controller.

EQUIPMENT

1. Simulation kit 2. CROs 3. Patch chords

THEORY

Proportional control mode : In this control mode, a smooth, linear relationship exists between the controller output and the error. For each value of error input, the controller gives out unique controller output in one-to-one correspondence.

Proportional band : The range of error to cover the 0% to 100% controller output is called the proportional band, because the one-to-one correspondence exists only for errors in this range. The Proportional mode can be expressed by P = P ep P = Kpep + p0 where Kp = proportional gain between error and controller output (% per %)

P0 = controller output with no error (%)

Characteristics of proportional mode :

1. If the error, ep is zero, then the controller output p = (Kp x 0) + P0 ρ a constant P0.

2. For every 1% of error, a correction of Kp percent is added or subtracted from P0, depending on the sign of the error.

3. There is a band of error about zero of magnitude PB within which the output is not saturated at 0% or 100%

Integral - control mode :

This mode is otherwise called as reset mode as the offset error in proportional mode can be reset to zero. In the proportional mode, offset error occurs because the controller cannot adapt to changing loads (external conditions). The zero error output is a fixed value. The problem is eliminated by the integral mode as the controller adapts to changing loads (external conditions) by changing the zero - zero output. Integral action is provided by summing the error overtime, multiplying that sum by a gain, and adding the result to the present controller output. If the error becomes positive or negative for an extended period of time, the integral action will begin to accumulate and make changes to the controller output. The integral mode is represented by the equation,

$$p(t) = KI \int_{0} e_p \, dt + p(o)$$

$$\frac{dp}{dt} = K_I e_p$$

Derivative - control mode : Derivative controller is otherwise called as rate controller or anticipating controller. The derivative mode is represented by the equation.

$$p(t) = K_D \frac{de_p}{dt}$$

where K_D = Derivative gain

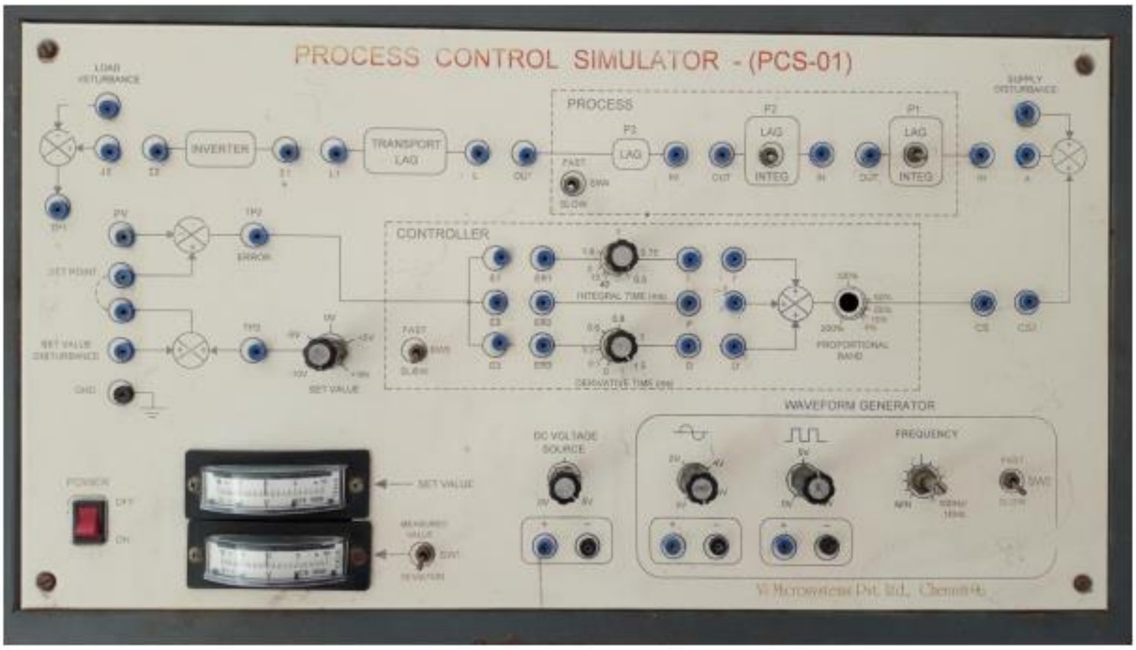


Fig. Experimental Setup

TABULATION

P CONTROLLER

Propotional Band	Rise Time (ms)	Peak Time (ms)	Peak Overshoot (V)	Settling Time (ms)	Offset (V)

PI CONTROLLER

Propotional Band	Rise Time (ms)	Peak Time (ms)	Peak Overshoot (V)	Settling Time (ms)

PID CONTROLLER

Propotional Band	Rise Time (ms)	Peak Time (ms)	Peak Overshoot (V)	Settling Time (ms)

RESULT

Thus, the dynamic characteristics of Proportional plus Integral plus Derivative controller were studied.

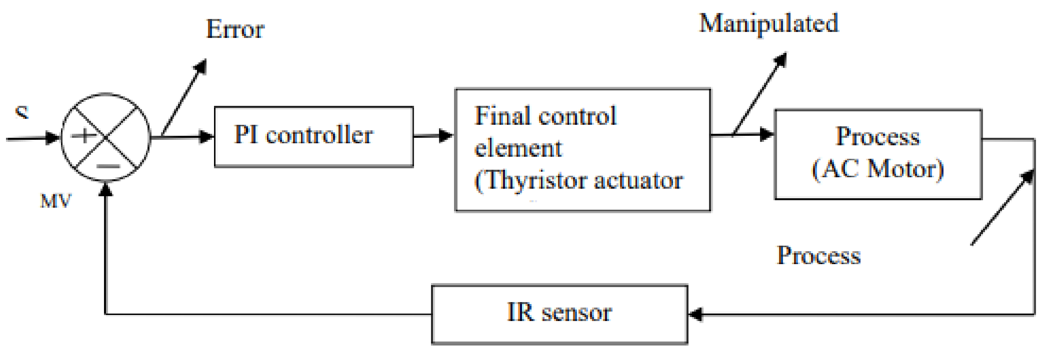
AIM

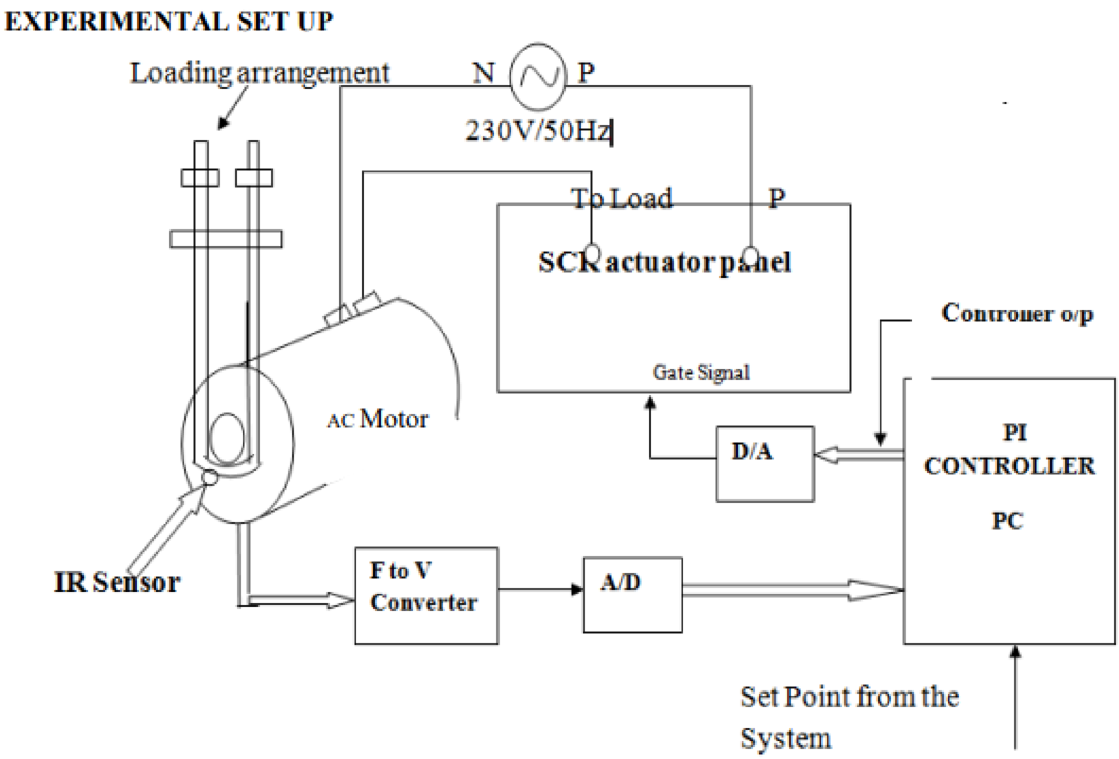
To study the closed loop response of AC Motor.

APPARATUS REQUIRED

1. AC Motor Speed Control Trainer 2. Computer with Printer 3. Patch Chords.

BLOCK DIAGRAM





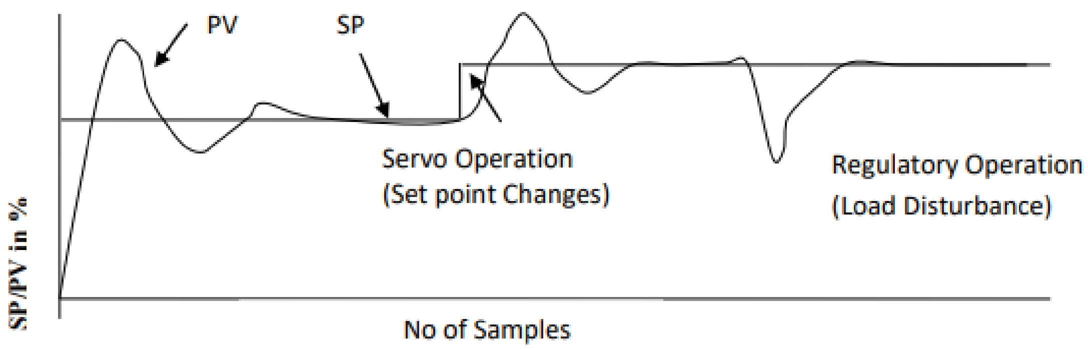
THEORY

PROCEDURE

1. Open 4T double PID MATLAB application Folder.
2. 2. Double click the install batch file.
3. 3. Double click the double PID MATLAB application file.
4. 4.First Click the Connection button .If you click the connection button pop up window will open which contain the connection succeed dialogue, then press ok button.

5. 5.Then click check box of PID 1 ,after enter the Ti= ,PB= , Kd= ,Td= ,Ts= , Sepoint = ,output lower limit=0 ,output upper limit =100 and make sure PID action is Reverse.
6. 6. Click the configure settings make sure SP from Panel, MV = CH0, DAC = DAC 1
7. 7. Click the Graph Settings Select PID 1 - SP(Black) , MV- CHO(Red) then click the OK Button
8. 8. Then if you click the Start Button the Response window will open.
9. 9. Observe the response.
10. 10 Change the different set point with the help of Pause and Resume button.
11. 11 Again observe the response.
12. 12. Apply the load disturbance with the help of the loading arrangement.
13. 13. Again observe the response.

MODEL GRAPH



RESULT Thus the closed loop response of ac motor using proportional integral controller was obtained.

AIM

To study the closed loop response of DC Motor.

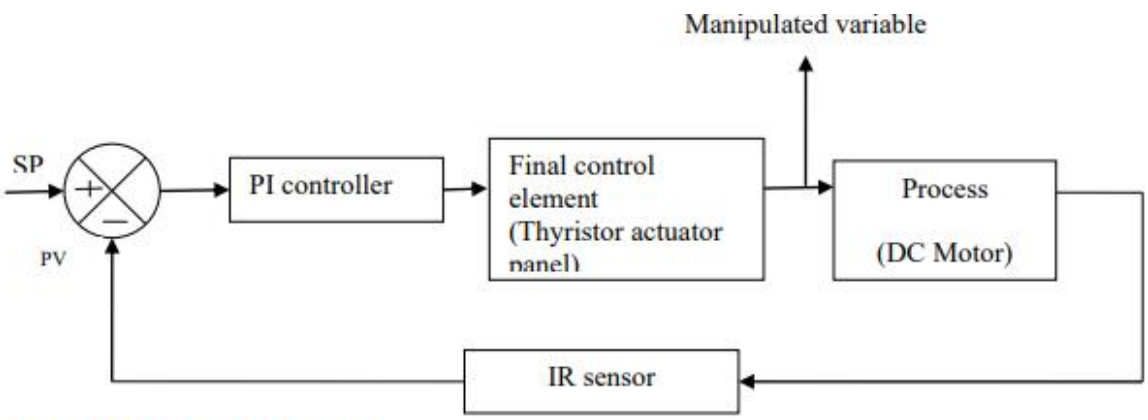
APPARATUS REQUIRED

1. DC Motor Speed Control Trainer

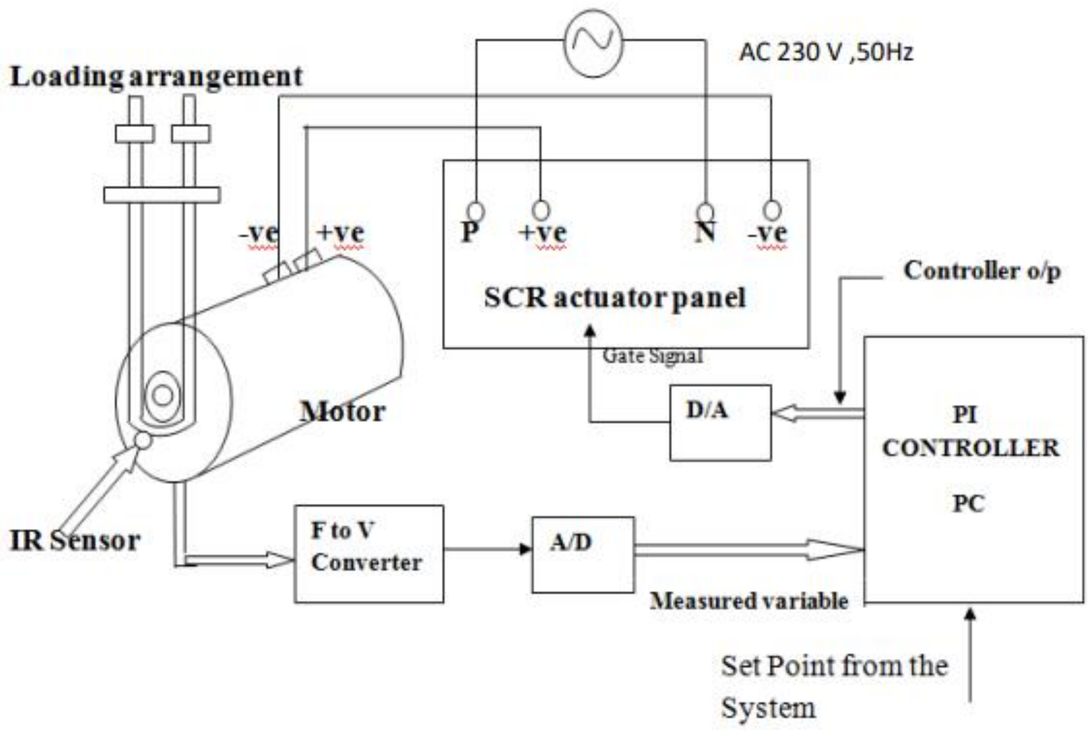
2. Computer with Printer

3. Patch Chords.

BLOCK DIAGRAM



EXPERIMENTAL SET UP



THEORY

PROCEDURE

1. Open 4T double PID MATLAB application Folder.

2. Double click the install batch file.

3. Double click the double PID MATLAB application file.

4.First Click the Connection button .If you click the connection button pop up window will open which contain the connection succeed dialogue, then press ok button.

5.Then click check box of PID 1 ,after enter the Ti= ,PB= , Kd= ,Td= ,Ts= , Setpoint = , output lower limit=0 ,output upper limit =100 and make sure PID action is Reverse.

6. Click the configure settings make sure SP from Panel, MV = CH0, DAC = DAC 1

7. Click the Graph Settings Select PID 1 - SP(Black) , MV- CHO(Red) then click the OK Button

8. Then if you click the Start Button the Response window will open.

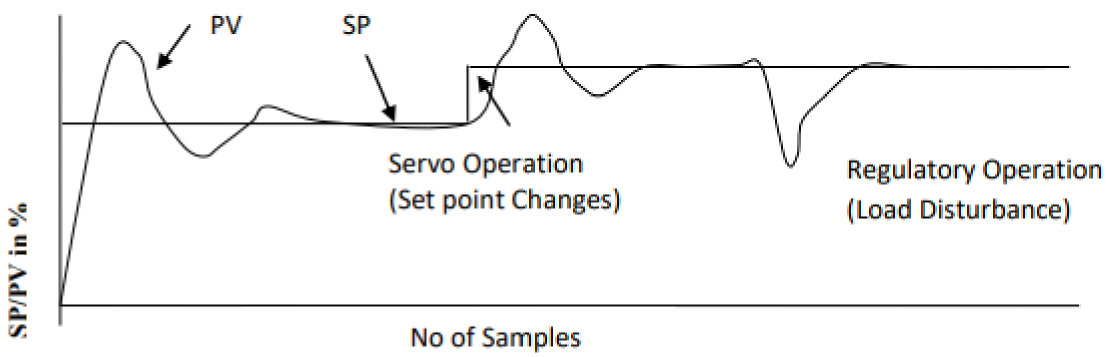
9. Observe the response.

10 Change the different set point with the help of Pause and Resume button.

11 Again observe the response.

12. Apply the load disturbance with the help of the loading arrangement. 13. Again observe the response

MODEL GRAPH



RESULT

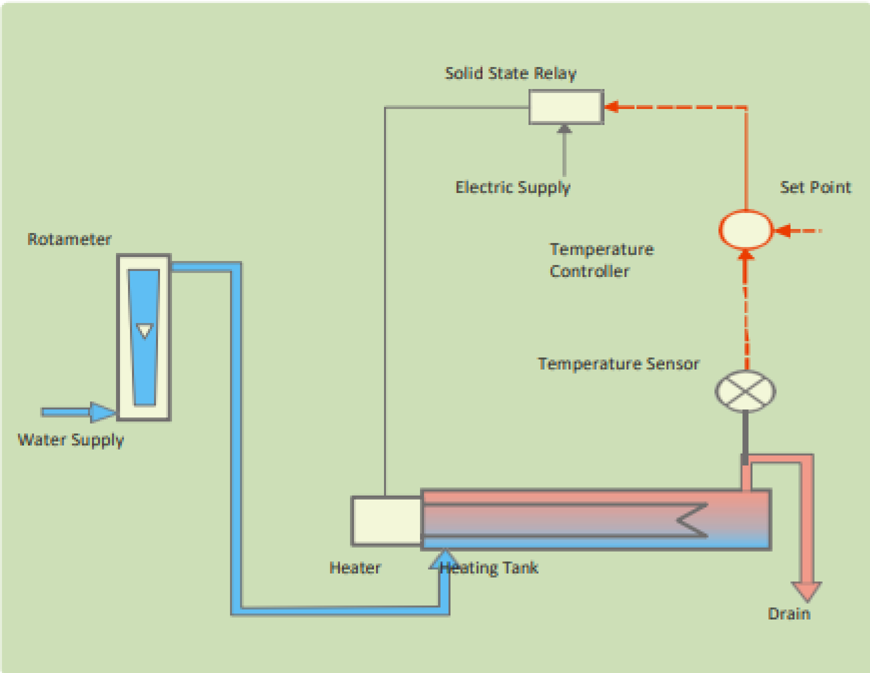
Thus the closed loop response of AC Motor using proportional integral controller was obtained.

Aim of the experiment:

To Studyof proportionalintegral controller

Apparatus required:- Temp control trainer

Theory: - Temperature control trainer is designed for understanding the basic temperature control principles. The process setup consists of heating tank fitted with SSRcontrolled heater for on-line heating of the water. The flow of water can be manipulated and measured by rotameter. Temperature sensor (RTD) is used for temperature sensing. The process parameter (Temperature) is controlled by microprocessor based digital indicating controller which manipulates heat input to the process. These units along with necessary piping and fitting are mounted on support frame designed fortabletop mounting.



Procedure

Start up set up as explained in general instructions.

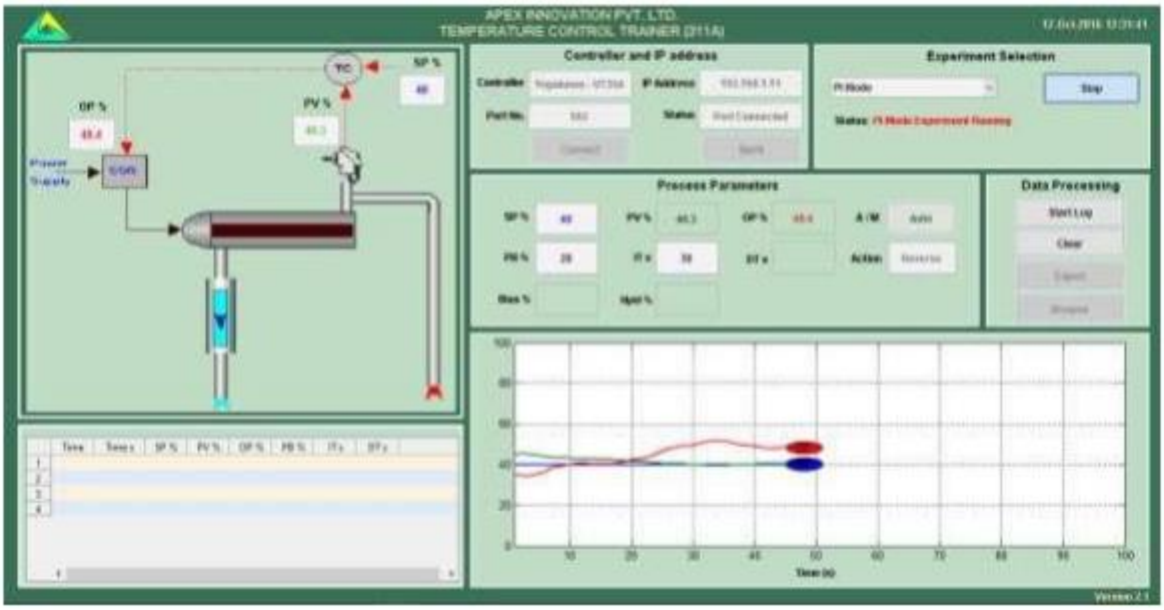
Click Select Experiment,select PIMode and click Start
Adjusttheprocessvaluebychangingtheoutputofcontrollerinmanualmodetoaparticular temperature (set point=40%).

Set the proportional band estimated from Proportional control (from previous experiment). Startwithderivativetime=0andintegraltime=1000sec.,whichwillcutoffthederivative action and widen the effect of integral action.

Allow the processto reach atsteady state. Record the steady state error.

Switchonthecontrollertomanualmode.Reducetheintegraltimetohalfoftheprevious value.SwitchtoAutomode andapplystepchangetothesetpointby2to3%.Notethe response of thesystem.

Usingtrialanderror,findoutanintegraltime,whichgivessatisfactoryresponsetothestep change in setpoint.



Observations

Observe the effect ofreducing integral time on offset and on the response ofthe process.

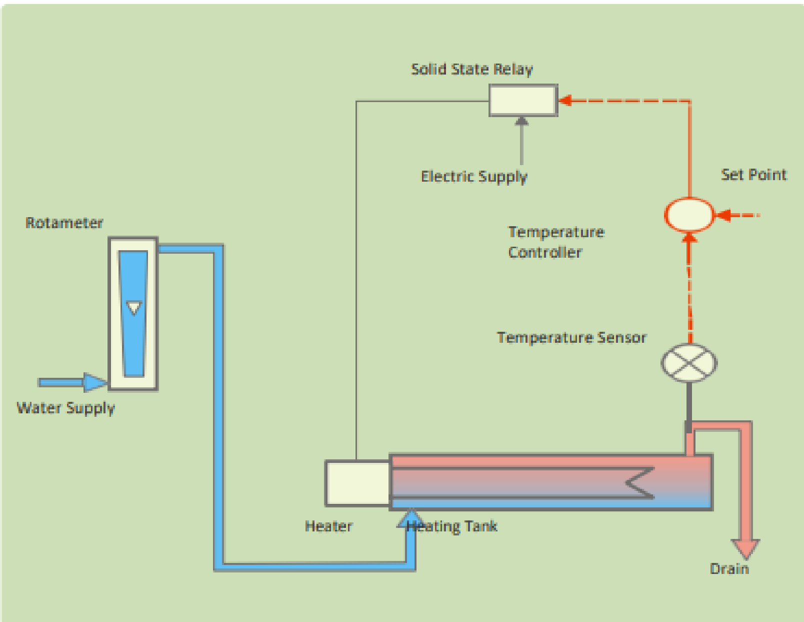
Aim of the experiment:-

To Study of proportional derivative controller

Apparatus required:-

Temp control trainer

Theory: - Temperature control trainer is designed for understanding the basic temperature control principles. The process setup consists of heating tank fitted with SSR controlled heater for on-line heating of the water. The flow of water can be manipulated and measured by rotameter. Temperature sensor (RTD) is used for temperature sensing. The process parameter (Temperature) is controlled by microprocessor based digital indicating controller which manipulates heat input to the process. These units along with necessary piping and fitting are mounted on support frame designed for tabletop mounting.

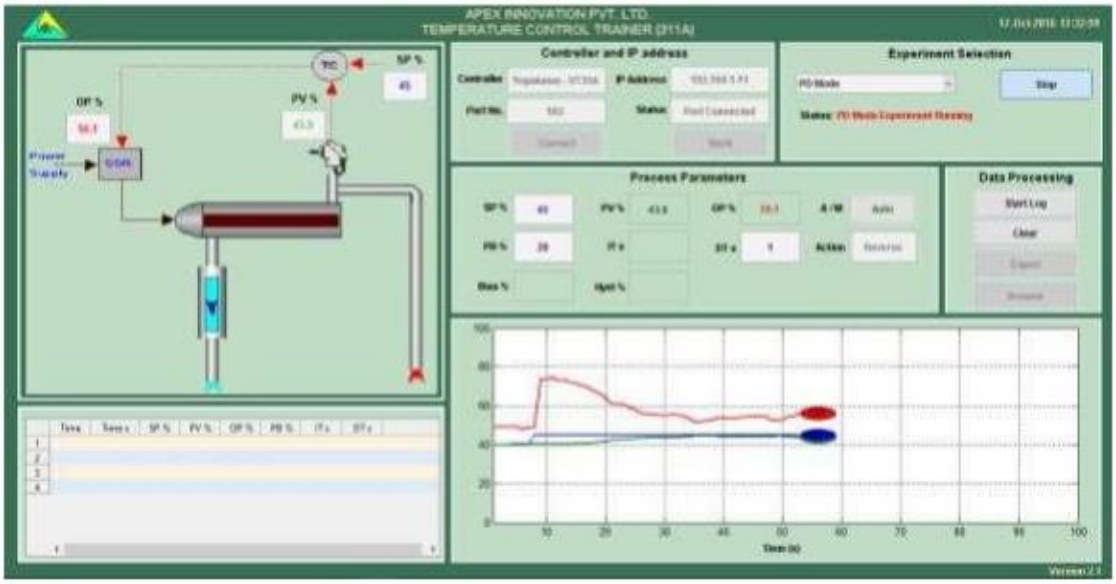


Procedure

- Start up set up as explained in general instructions.
- Click Select Experiment, select PD Mode and click Start
- Set the proportional band estimated from Proportional control (P only). Start with derivative time=0 and integral time=6000 sec., which will cut off the derivative action and widen the effect of integral action.
- Set the set point to desired temperature (@40%). Allow the process to reach at steady state.

Note the response of the system.

- Switchonthecontrollertomanualmode.Increasethederivativetimeby1 sec.Switchto Automodeandapplystepchangetothesetpointby2 to 3%.Notetheresponseofthe system.
- Increase the derivative time gradually and observe the process response for step change.



Observations

- Observe the effect of increasing derivative time. Also note that the process may show offset as effect of integral action is cut off.

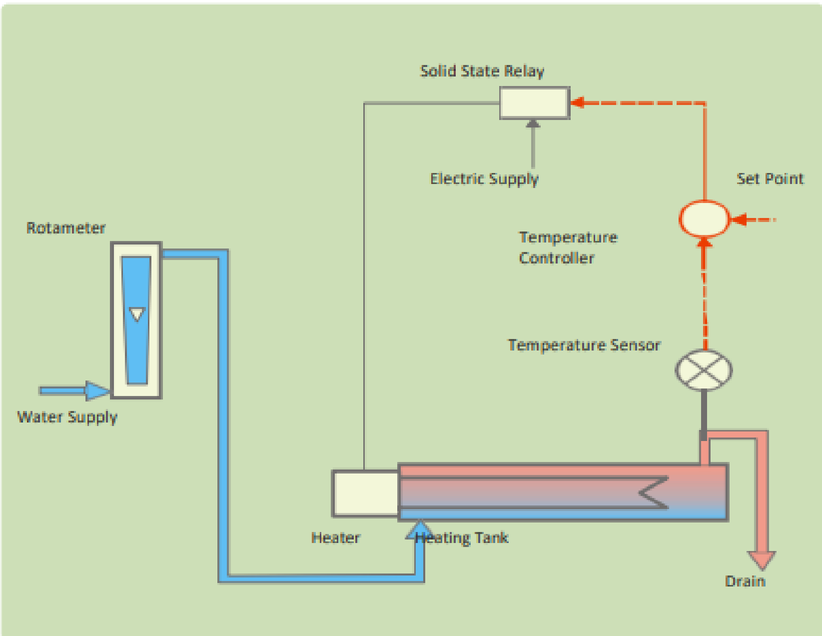
Aim of the experiment:-

To Study of proportional integral derivative controller

Apparatus required:-

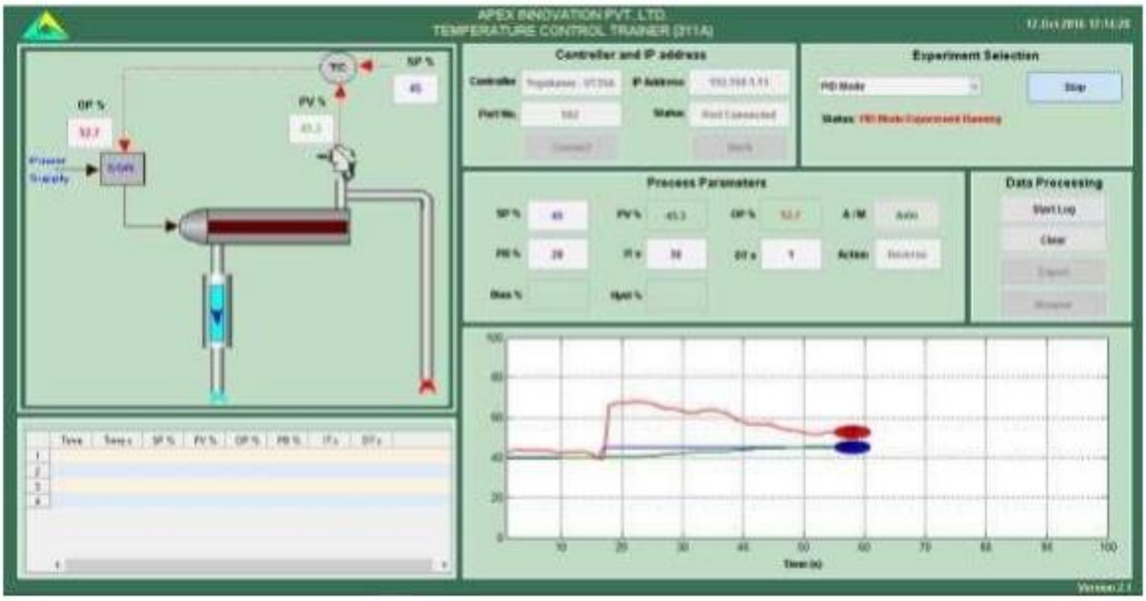
Temperature control trainer

Theory: - Temperature control trainer is designed for understanding the basic temperature control principles. The process setup consists of heating tank fitted with SSR controlled heater for on-line heating of the water. The flow of water can be manipulated and measured by rotameter. Temperature sensor (RTD) is used for temperature sensing. The process parameter (Temperature) is controlled by microprocessor based digital indicating controller which manipulates heat input to the process. These units along with necessary piping and fitting are mounted on support frame designed for tabletop mounting.



Procedure

- Start up set up as explained in general instructions.
- Click Select Experiment, select PID mode and click Start
- Switch the controller to manual mode.
- Change the proportional band to the value that estimated in proportional controller. Set integral time and derivative time based on the responses in previous experiments.
- Change the controller to Auto mode. Apply step change by 2 to 3% to the set point and observe the response of the process.
- Change the proportional band, integral time, derivative time and observe the response of the process for step change for each change in setting.



Observations

- Compare the steady state response of the PID controller with P, PI and PD controller obtained in the previous experiments.