PROCESS CONTROL TRAINER *(a familiy of training system)*

Flow/Level with Variable Speed Pump
(Model : XPO-PCT-FLE)

USB to IO converter cable

Flow/Level with Pneumatic Control Valve
(Model : XPO-PCT-FL)

SALIENT FEATURES

◆ Lightweight, yet sturdy, tabletop, Aluminium profile flat panel setup, with SS (304/316) piping for and wide angle view of every component in process. No hidden parts.

◆ Individual control loops as well as Advance control schemes like Ratio, Cascade, Feed forward, **coupled tank** made easy for student.

◆ Connection through polarized FRC connectors, sturdy 4mm Banana sockets & Patch cords enabling quick setting up of variety of process control experiments.

◆ Win7/8/10 Window Based PID Controller **(DDC)** software package with P, PI & PID control, Ratio & cascade control, three operating modes, Online graph drawing & data acquisition modes **(SCADA)**. PC not in scope of supply

◆ Useful for Post Graduate projects and research purpose.

◆ Optionally SDK for Matlab & Labview provided.
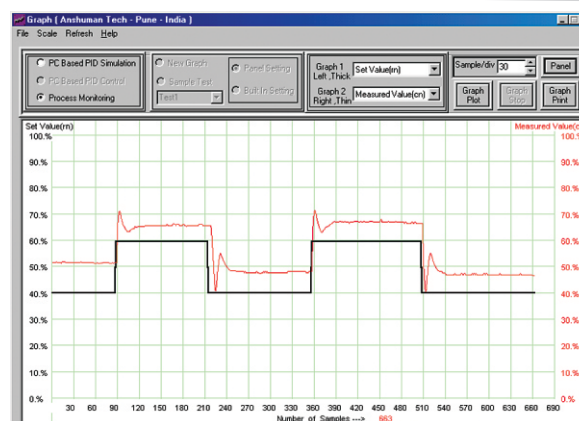
Technical Specifications (Controller Section)

◆ **Computer Interface panel (CIP/PCT1)**

● Connects to PC (Win7/8/10) USB port through USB to IO Module & type to mini B cable.

● 4 ADC channels I/P: 0 to 2.5V FS with 1no input simulation pot. 1 DAC channel O/P 2.5V FS.

● V to I function block: I/P 0 to 2.5V & O/P 0-20 or 4-20mA (100 ohm load) switch settable.

● I to V function block : I/P 4 to 20mA & O/P 0 - 2.5V

● USB IO module to interface 25 pin D connector on CIA panel to USB PC port enclosed in 25 Pin D shell using Type A to mini B cable.

● Optionally hardware module of square root extractor is provided so that PLC/Panel mount PID may be interfaced.

◆ **Instrumentation Power supply cum Multichannel DPM panel (EMT 8)**

● ±12V/500 mA, +5V/300mA, Unregulated 17V dc/750 mA, line synchronizing signal, 13V / 3 Amp.

● Multi channel DPM for digital display of process parameters.

● 20 pin FRC power bus to supply power to neighbouring panels.

◆ **Thyristor Actuator cum signal conditioning panel (TAP) / CE2 x 2No. (For only FLE)**

● Optionals: Thyristor bridge based 0-200V/3A using cosine firing circuit, I/P 0 to 2.5Vdc.

● Supports signal conditioning for RTD, Pressure sensor with

Instrumentation Amplifier & flow sensor (water / air) with F to V converter to generate 0-2.5Vdc (FS).

● 2 No. panels needed to cover signal conditioning needs of the selected process.

◆ **PC (WIN7/8/10) based digital PID controller (PC not in scope of supply but PC with USB port needed)**

● **Online monitoring / Data acquisition / PID Software**

on Installable (CD) works under XP, WIN7. PC with parallel port / USB needed.

● **Operating modes**

a) **Simulator Mode :** Tests data stored in files (*.txt) & Draw graph for all P,PI,PD & PID modes.

b) **Process Monitoring Mode :** Draw graphs of analog data presented at CH 0 & CH 1 of CIP. Cursors for X & Y axis for measurement & online graphs saving for reproduction.

c) **PID controller Mode**

● PID controller with parameter like Integral Time Ti (0.01-64000), Sampling Time Ts(0.1-99.9), Derivative Time Td(0-99.9), Proportional Band Pb(1-999), Derivative Gain Kd(1-999), Set Value Rn(0-99.9), PID output Upper Limit Uh(0-99.9), PID output Lower Limit Ul (0-99.9).

● Facility to set units for output viz. (%) °C , RPM, V, mm, LPH, kg/cm², msi/cm, Degree optionally experiments with advance process control scheme viz; Ratio, Cascade, feedforward with Aux PID, Ratio station & FF transfer function calculator, Alarm setting,

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ON/OFF control, square root extractor for Orifice.
- Function Generator : Sine / Triangular / Square wave generator

with frequency 0.01 Hz to 1 Hz, Amplitude is 0 to 2.5 V i.e. 0 - 100%.

Technical Specifications :

Process Loops [Parameters]	Flow/Level with variable speed pump (Model : XPO:PCT/FLE)	Flow/Level with pneumatic control value (Model : XPO- PCT/FL)
Controlled Medium	Water	Water
Storage tank material/Capacity	1 No. 50 ltr, plastic/PVC.	1 No. 20 ltr, plastic/PVC
Process tank capacity / material	Vertically mounted tank 1 No. 18 liters, liters, plexigalss (130x130x1050mm)	Vertically mounted tank 1 No. 18 liters, liters, plexiglass (130x130x1050mm)
Electric sensor Type/output/ Range	• Flow: Turbine flow sensors 2 No. • Level WC pressure sensor 0 to 500 mm, level measurement by bubbler method, O/P= 0 to 2.5V. Pressure supplied through small compressor & AFR	• Flow: Turbine flow sensors 1+1 No. (Optionally 1 No. Orifice plate with DP sensor, (0.5 PSI) O/P - 0 to 2.5V, 0-200 LPH • Level WC pressure sensor 0 to 500 mm, level measurement by bubbler method, O/P - 0 to 2.5V (optionally) capacitive sensor needs panel MIT-2
Control Valve	Fraction HP universal motor operated variable speed pump driven from TAP (EMT9) panel, I/P 0 to 2.5V O/P 0 to 195Vdc, Pump Speed : 0-3000RPM	Pneumatically operated air to close, liner type ½" Size Diaphragm operated, CV =0.4 with I to P. Converter I/P 4 to 20mA, O/P 3 to 15 psi.
Rotameter	2 Nos. Acrylic body 1/2" size 0 to 200LPH	2 Nos. Acrylic body 1/2"size 0 to 200LPH
Generation & Distribution Pump	1 No. 0.062KW, 1/12HP,2800RPM, 1/2"outlet, 500 LPH. Head 9 meters, with brass impeller + 1 no. AC motor pump (8 mtr head) for wild flow	1 No. 0.062KW, 1/12HP,2800RPM 1/2" outlet, 500LPH. Head 9 meters, with brass impeller
Bourden gauges	0 to 500mm of water column= 1 No.	4 Nos. (0 to 2 bars, 3 Nos. 0 to 500mm of water column=1 No.)
Manual SS valves Piping material/size	1/2" size =4 nos., 1/4" size = 3 nos. Stainless steel 1/2" for water, 1/4" for air	1/2" size =4 Nos., 1/4" size = 3 nos. Stainless steel 1/2" for water, 1/4" for air
Air filter & regulators OR accessaries	1 No, 0 to 1 bars, size 1/4"	2 Nos, 0 to 10 bars, size 1/4", Oil catcher (1/4" size max. pressure= 10 bars) 1No.
Air compressor	-----	0 to 7 bars, 1/2 HP, 230VAC supply (optional)
Mech. Size/wt	1170(L) X 300(W) X 990(H)mm /38kg.	1170(L) X 300 (W) X 990(H)mm /38kg.
Advance control expt. Ratio Cascade Feedforward	Transfer function determination Ziglor Nicholas PID tunning Between 2 water flows Inner (fast) loop flow, outer(slow) loop level Water flow disturbance on level loop.	
List of Experiments	1. Study of Level loop-open response & close loop response with P, PI, PID. 2. Study of Flow control loop - open loop response & close loop response with P, PI, PID. 3. Study of Flow control by Thyristorised control of pump 4. Study of Ratio control loop 5. Study of Cascade control loop 6. Study of Level ON-OFF control loop 7. Study of Feed - Forward control loop	1. Study of Level loop-open response & close loop response with P, PI, PID. 2. Study of Flow control loop - open loop response & close loop response with P, PI, PID. 3. Study of control valve, equal % (Gain scheduler Hysteresis), Quick opening & linear, V to I converter, I to P converter. 4. Study of Ratio control loop 5. Study of Cascade control loop 6. Study of Level ON-OFF control loop 7. Study of Feed - Forward control loop 8. Study of Pressure loop
Optional	PLC interface will be provided	

PROCESS CONTROL TRAINER

Pressure/Temperature/Flow
(Model : XPO-PCT-PTF)
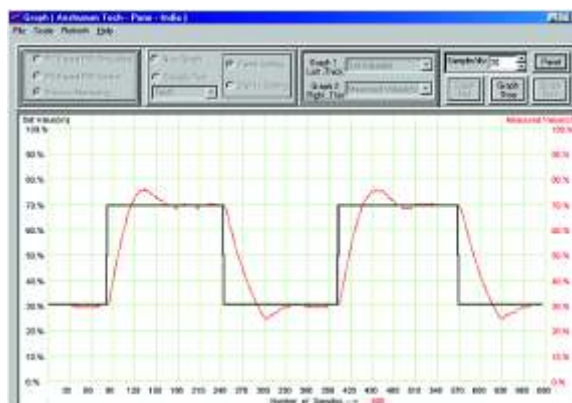
Coupled Tank
(Model : XPO-PCT-3T)

SALIENT FEATURES

- Lightweight, yet sturdy, tabletop, Aluminium profile flat panel setup, with SS (304/316) piping for and wide angle view of every component in process. No hidden parts.
- Individual control loops as well as Advance control schemes like Ratio, Cascade, Feed forward, **coupled tank** made easy for student.
- Connection through polarized FRC connectors, sturdy 4mm Banana sockets & Patch cords enabling quick setting up of variety of process control experiments.
- PC/XP/win7/8/10 window based PID controller **(DDC)** software package with P, PI & PID control, Ratio & cascade control, three operating modes, Online graph drawing & data acquisition modes **(SCADA)**. PC not in scope of supply
- Useful for Post Graduate projects and research purpose.
- Optionally SDK for Matlab & Labview provided.

Technical Specifications (Controller Section)

◆ Computer Interface panel (CIP)

- Connects to PC (WIN7/8/10) USB port through USB IO module & type A to mini B cable.
- 4 ADC channels I/P: 0 to 2.5V FS with 1no input simulation pot. 1 DAC channel O/P 2.5V FS.
- V to I function block: I/P 0 to 2.5V & O/P 0-20 or 4-20mA (100 ohm load) switch settable.
- I to V function block : I/P 4 to 20mA & O/P 0 - 2.5V
- USB IO module to interface 25 pin D connector on CIA panel to USB PC port enclosed in 25 Pin D shell using Type A to mini B cable.

◆ Instrumentation Power supply cum Multichannel DPM panel (EMT 8)

- DC Multi Output power supply.
- Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.
- Multi channel DPM for digital display of process parameters.
- 20 pin FRC power bus to supply power to neighbouring panels.

◆ Thyristor Actuator cum signal conditioning panel (TAP) / CE2 x 3Nos.

- Thyristor bridge based 0-200V/3A using cosine firing circuit, I/P 0 to 2.5Vdc.
- Supports signal conditioning for RTD, Pressure sensor with Instrumentation Amplifier & flow sensor (water / air) with F to V converter to generate 0-2.5Vdc (FS).

- Closed loop control experiments based on Temperature, Flow, Pressure measurement using Digital PID controller.
- 2 Nos. panels may be needed to cover signal conditioning needs of the selected process.

◆ PC (WIN7/8/10) based digital PID controller (PC not in scope of supply but PC with USB port needed)

- **Online monitoring / Data acquisition / PID Software** on Installable (CD) works under XP, WIN7/8/10. PC with parallel port /USB needed.
- **Operating modes**
  a) **Simulator Mode :** Tests data stored in files (*.txt) & Draw graph for all P,PI,PD & PID modes.
  b) **Process Monitoring Mode :** Draw graphs of analog data presented at CH 0 & CH 1 of CIP. Cursors for X & Y axis for measurement & online graphs saving for reproduction.
  c) **PID controller Mode**
- PID controller with parameter like Integral Time Ti (0.01-64000), Sampling Time Ts(0.1-99.9), Derivative Time Td(0-99.9), Proportional Band Pb(1-999), Derivative Gain Kd(1-999), Set Value Rn(0-99.9), PID output Upper Limit Uh(0-99.9), PID output Lower Limit Ul (0-99.9).
- Facility to set units for output viz. (%) °C, RPM, V, mm, LPH, kg/cm², msi/cm, Degree with advance process control scheme viz; Ratio, Cascade, Feedforward with Aux PID, Ratio control & FF transfer function calculator, Alarm setting, ON/OFF control, square root extractor for Orifice.

230111

- Function Generator : Sine / Triangular / Square wave generator with frequency 0.01 Hz to 1 Hz, Amplitude is 0 to 2.5 V i.e. 0 - 100%.

Technical Specifications :

| Parameters	Pressure/Temperature/Flow (Model : XPO-PCT-PTF)	Coupled Tank : (Model XPO-3T)
Controlled Medium	Air for Pressure / Flow, Water for Temp. & Air (air bubbler) for Cooling	Water
Storage Tank Material/Capacity	1 No., 8 litre plexiglass tank for water	1 No., 20 litre plastic/PVC
Process Tank Capacity/Material	1 No. 4 liter, stainless steel tank with temp, pressure sensors attachment. Pressure relief valve (Tank size : dia = 140 mm, Length = 294 mm)	3 Numbers. of 10 Litres., plexiglass (130 x 130 x 350mm) tanks, coupled using manual valves
Electronic Sensor type/O/P/ Range	• Pressure: piezo-resistive pressure sensor 0 to 30PSI, O/P = 0 to 2.5V • Temp: PT100, O/P =0 to 2.5V, ambient to 100°C • Flow Turbine flow sensor 1 No. O/P - 0 TO 2.5V, 0-50 LPM	• 2 Nos. Level sensors WC pressure sensor 0 to 250mm, O/P 0 to 2.5V. • 2nd sensor shared between two tanks using 6 way manifold block & 1/4" ball valve (2 Nos.)
Control Valve	Pneumatically operated air to close, linear type, 1/2" Size Diaphragm operated, C=0.4 with I to P Converter I/P 4 to 20mA O/P 4 to 20 mA O/P 3 to 15 psi.	2 Nos. of variable speed motorized pump driven from EMT9 (2Nos.) or PE6 Panel I/P 0 to 2.5 V, O/P 0 to 195VDC, Pump Speed = 0 to 4000 RPM
Rotameter	2 Nos. Acrylic body 1/2" size 0 to 50 LPM	2 Nos. Acrylic body 1/2" size 0 to 200 LPM
Generation & Distribution Pump	230VAC 10W submersible water pump with ¼" pvc pipe to fill in process vessel for temperature control experiment.	2 No. 0.06KW, 1/12 HP, 4000RPM 1/2" outlet, 500 LPH each, head 9 mtrs. with brass impeller.
Bourdon Gauges	2 Nos. 0 to 2 bars, 2 Nos. 0 to 10 bar 0-100°C gauge thermometer	0 to 300 mm of water column = 2 Nos.
Manual SS valves	1/4" size = 7 Nos.	
Piping Material / size	Stainless steel, 1/4" for air	Stainless steel 1/2" for water, 1/4" for Air bubbler & back pressure PU (6X4) only
Air filter & regulators or accessaries	3 Nos., 0 to 10 bars size ¼" Oil catcher (1/4" size maximum pressure = 19 bars) = 1No.	2 nos. of Air regulator, 0 to 1 bar, size 1/4"
Air Compressor	0 to 10 Bars, 2 HP, 230VAC Supply (optional), Tank Capacity : 110 liters.	---
Mechanical Size/Weight	1165(L) X 300 (W) X 990(H)mm / 40 Kg.	1165(L) X 300 (W) X 990(H)mm / 40 Kg.
Advance control Expt. - Ratio - Cascade - Feed Forward	Between 2 air flows Inner loop flow. Outer loop temp. Air flow on temp. loop.	• Study of interactive & noninteractive systems. • Experiments on - 1st order SISO, 2nd order SISO (interactive & non interactive cascade control, Introduction of MIMO.
List of Experiments	1. Study of temperature control loop- open loop response & close loop response with P,PI,PID. 2. Study of pressure control loop-open loop response & close loop response with P,PI,PID. 3. Study of Air flow Control loop- open loop response & close loop response with P,PI,PID. 4. Study of Ratio Control loop 5. Study of Cascade control loop 6. Study of ON-OFF control loop 7. Study of Feed - forward Control loop 8. Study of Control Valve (Gain scheduler, Hysteresis), V to I converter, I to P converter	Study of Level loop by: 1. First Order SISO - open loop response & close loop response with PID. 2. Second Order SISO non Interactive- close loop response with PID. 3. Second Order SISO Interactive- close loop response with PID. 4. Cascade Control 5. MIMO- open loop response & close loop response with PID.
Optional	PLC based controller can be provided needs to purchase XPO-PLC trainer separately.	

Air Compressor (10 Bar) →

USB to IO converter cable →

PROCESS CONTROL TRAINER Shell Tube Heat Exchanger
(Model : XPO-STHE)
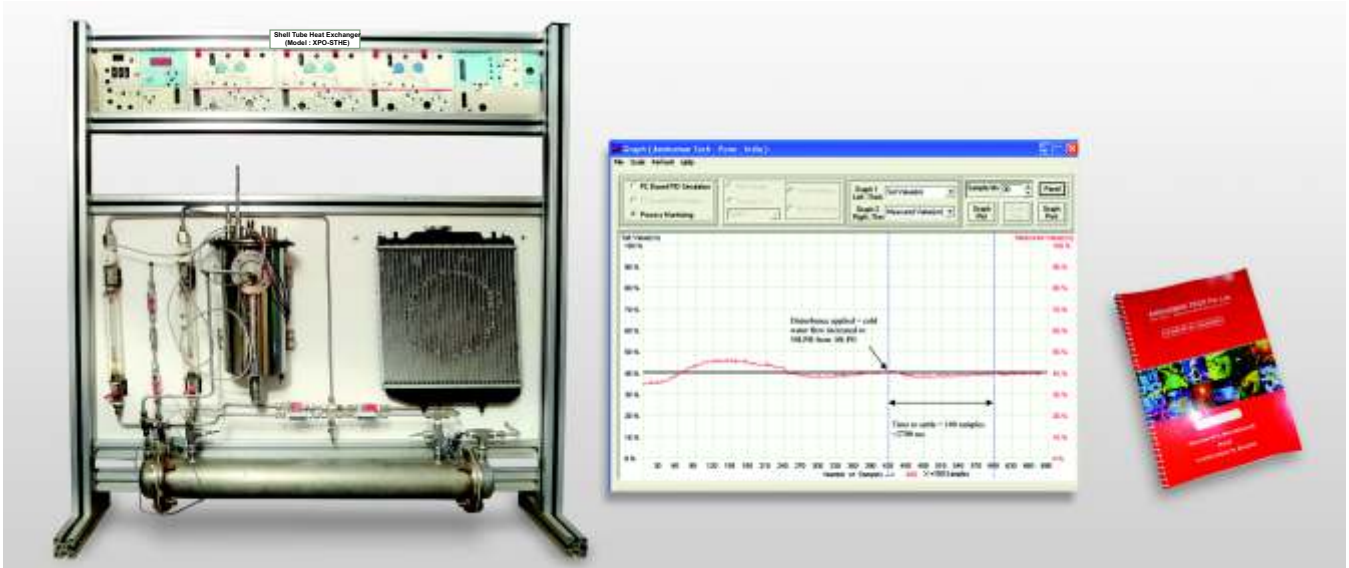
SALIENT FEATURES

◆ Lightweight, yet sturdy, tabletop, Aluminium profile flat panel setup, with SS (304/316) piping for and wide angle view of every component in process. No hidden parts.

◆ Individual control loops as well as Advance control schemes like Ratio, Cascade, Feed forward, **coupled tank** made easy for student.

◆ Connection through polarized FRC connectors, sturdy 4mm Banana sockets & Patch cords enabling quick setting up of variety of process control experiments.

◆ WIN7/8/10 based PID controller **(DDC)** software package with P, PI & PID control, Ratio & cascade control, three operating modes, Online graph drawing & data acquisition modes **(SCADA)**.
PC not in scope of supply

Technical Specifications (Controller Section)

◆ Computer Interface panel (CIP)

● Connects to PC (WIN7/8/10) USB port through USB IO module & type A to mini B cable.

● 4 ADC channels I/P: 0 to 2.5V FS with 1no input simulation pot. 1 DAC channel O/P 2.5V FS.

● V to I function block: I/P 0 to 2.5V & O/P 0-20 or 4-20mA (100W load) switch settable.

● I to V function block: I/P 4 to 20mA & O/P 0 - 2.5V

● USB IO module to interface 25 pin D connector on CIA panel to USB PC port enclosed in 25 Pin D shell using Type A to mini B cable.

● Optionally hardware module of square root extractor is provided so that PLC/Panel mount PID may be interfaced.

◆ Instrumentation Power supply cum Multichannel DPM panel (EMT 8)

(a) DC Multi Output power supply.

(b) Supplies DC power to neighbouring signal conditioning circuit panels like EMT9, CIP1, CIP2, MIT12, CE7 etc. through 20 pin FRC cable.

c) Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.

d) Multichannel 4 positon DPM for process parameters.

◆ Thyristor Actuator cum signal conditioning panel (TAP) / CE2 x 2Nos.

● Thyristor bridge based 0-200V/3A using cosine firing circuit, I/P 0 to 2.5Vdc.

● Supports signal conditioning for RTD with Instrumentation Amplifier to generate 0-2.5Vdc (FS).

● 2No. panels may be needed to cover signal conditioning needs of the selected process.

◆ Pressure/ Temperature sensor panel (PT7/CE8)

● Provides 4 blocks of temperature (PT100) / pressure sensor interface & 3 blocks of temperature (PT100) / speed or flow sensor interface which can be use to interface 7 temperature to output 0 to 2.5VDC. (FS).

● Span/ zero adjustment amplifier.

◆ PC (WIN7/8/10) based digital PID controller (PC not in scope of supply but PC with USB port needed)

● **Online monitoring / Data acquisition / PID Software** on Installable (CD) works under XP, WIN7/8/10. PC with parallel port / USB needed.

● **Operating modes**

a) **Simulator Mode :** Tests data stored in files (*.txt) & Draw graph for all P,PI,PD & PID modes.

b) **Process Monitoring Mode :** Draw graphs of analog data presented at CH 0 & CH 1 of CIP. Cursors for X & Y axis for measurement & online graphs saving for reproduction.

c) **PID controller Mode**

● PID controller with parameter like Integral Time Ti (0.01-64000), Sampling Time Ts(0.1-99.9), Derivative Time Td(0-99.9), Proportional Band Pb(1-999), Derivative

230111

Gain Kd(1-999), Set Value Rn(0-99.9), PID output Upper Limit Uh(0-99.9), PID output Lower Limit Ul (0-99.9).

- Facility to set units for output viz. (%) ^{o}C , RPM, V, mm, LPH, kg/cm², µsi/cm, Degree. Optionally experiments with advance process control scheme viz; Ratio, Cascade, feedforward with Aux PID, Ratio station & FF transfer function calculator, Alarm setting, ON/OFF control, square root extractor for Orifice.

- Function Generator : Sine / Triangular / Square wave generator with frequency 0.01 Hz to 1 Hz, Amplitude is 0 to 2.5 V i.e. 0 - 100%.

- Facility to set units for output viz. (%) ^{o}C , RPM, V, mm, LPH, kg/cm², µsi/cm, Degree. Optionally experiments with advance process control scheme viz; Ratio, Cascade, feedforward with Aux PID, Ratio station & FF transfer function calculator, Alarm setting, ON/OFF control, square root extractor for Orifice.

- Function Generator : Sine / Triangular / Square wave generator with frequency 0.01 Hz to 1 Hz, Amplitude is 0 to 2.5 V i.e. 0 - 100%.

Technical Specifications :

Parameters	Shell Tube Heat Exchanger [Model : XPO-STHE]
Controlled Medium	Water
Storage tank material/Capacity	2 No. 50 ltr each, Hot Return sump & Cold Sump, plastic / PVC. 1 No. 5 liter, stainless steel tank with Heater
Process tank capacity/material	STHE : Shell - 100 Φ x 800 mm, 1/4" NPT (F) socket-4 Nos., 2 drain sockets, 4 baffles, 1 pass, Tube : 6 Φ x 10 Nos. x 680 mm, 304SS, Weight <10kg
Electronic sensor type/O/P/ range	• Temp: PT100, 4nos, encapsulated in SS tube (12mm length/3Φ dia),with 1/4" male NPT plug with 3 wires flying leads 1mtr length and terminated on 5 pin DIN connector, O/P =0 to 2.5V ambient to 100^{0}C • Flow Turbine flow sensor 2No.,OP=0 to 2.5V, 0-100LPH
Control Valve	2 nos Fraction HP universal motor operated variable speed pump driven from TAP (EMT9) panel, I/P 0 to 2.5V, O/P 0 to 195Vdc, 0-3000RPM, TAP panel : SCR controlled full bridge (200Vdc) for 750W for temp. control. I/P - 0 to 2.5Vdc.
Rotameter	2 No. Acrylic body 1/2" size 0 to100LPH
Generation & Distribution Pump	2 No. 0.062KW, 1/12HP, 2800RPM, 1/2" outlet, 500 LPH. Head 9 mtrs, with brass impeller, Radiator to cool Hot water sump.
Bourdon gauges	0-100^{0}C gauge thermometer display hot water temp in boiler.
Manual SS valves	1/4" size = 6 nos. 1/2" size = 2 nos..
Piping material/size	Stainless steel 1/4" size, Return piping using rainforced plastic**.**
Mech. Size/wt	1165(W) X 300 (W) X 990(H)mm /49kg.
Advance Control Experiments -Ratio	1) LMTD calculation for Co-current or parallel flow heat exchanger 2) LMTD calculation for Counter-current flow heat exchanger 3) Open loop response of Cold water outlet sensor i.e. determination of PID parameters. 4) Open loop response of Hot water inlet sensor i.e. determination of PID parameters.
Additional Experiments • **Cascade** • **Feedforward**	1) To Study of Characterization of HE 2) Cascade: Between 2 temperatures 3) Feedforward: Water flow disturbance on temperature loop

PROCESS CONTROL TRAINER PH / Conductivity (Model : XPO-ChemPCT)

SALIENT FEATURES

◆ Can learn about pH & conductivity measurement and control, with pH effective range is between 4 to 11 pH beyond this limit the response becomes slow & amount of time & pH solution needed to change increase exponentially & hence not practical.

◆ Lightweight, yet sturdy, tabletop, Aluminium profile flat panel setup, with teflon PVC piping for acid/base delivery and wide angle view of every component in process. No hidden parts.

◆ Individual control loops as well as Advance control schemes like Split Control made easy for student.

◆ Connection through polarized FRC connectors, sturdy 4mm Banana sockets & Patch cords enabling quick setting up of variety of process control experiments.

◆ PC (WIN7/8/10) window based multi PID controller **(DDC)** software package with P, PI & PID control, Ratio & cascade control, three operating modes, Online graph drawing & data acquisition modes **(SCADA)**. PC not in scope of supply. Matlab /LV SDKs supplied optionally.

◆ Useful for Post Graduate projects and research.

◆ Use of Citric Acid (20 gmpl/150gmpl) & Caustic Soda (10 gmpl/100gmpl) for PH & conductivity experiment respectively.

Technical Specifications (Controller Section)

◆ **Instrumentation Power supply cum Multichannel DPM panel (EMT 8)** [10 banana sockets]

• DC Multi Output power supply.

• Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.

• 20 pin FRC power bus to supply power to neighbouring panels.

◆ **Computer Interface panel (CIPII)** [13 banana sockets]

• Connects to PC (WIN7/8/10) parallel port through 25 pin M to F cable / 1.5mtr.

• 8 ADC channels I/P: 0 to 2.5V FS with 1 no. input simulation pot. 2 DAC channel O/P 2.5V FS.

• V to I function block: I/P 0 to 2.5V & O/P 0-20 or 4-20mA (100 ohm load) switch settable.

• I to V function block : I/P 4 to 20mA & O/P 0 - 2.5V
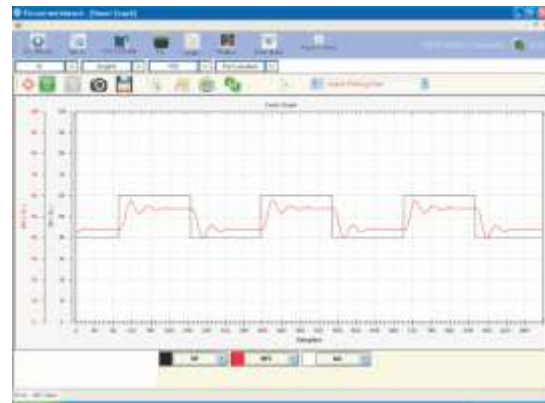
• USB converter to interface 25 pin D connector on CIP panel to USB enclosed in 25 Pin D shell using Type A to mini B cable.

◆ **V to I Converter panel** [10 banana sockets]

• (CIP x 2 Nos.) mounted one below another.

• V to I function block: I/P 0 to 2.5V & O/P 0-20 or 4-20mA (100 ohm load) switch settable. - 2 Nos.

• I to V function block : I/P 4 to 20mA & O/P , 0 - 2.5V - 2 Nos.

• 1 no. input simulation pot.

◆ **PH sensor signal conditioning panel [CE5]** [3 banana sockets]

• Consisting of 96 x 96 mm digital meter for PH display [4 digit], Range : 0 to 14.00 PH.

• Connects to external PH sensor using BNC connector.

• Retransmission output : 4 to 20 mA.

• Aux. Supply needed : 230VAC/50Hz.

• *PH Sensor Supplied :*

• Connect using BNC connector.

• Type : Combination

• Sensor O/P : mV (+/- 59.4mV/PH change @25^{0}C

• Lab grade sensor assembly.

- Operating Pressure : 0 to 6 Bar.
- Junction : Four ceramic Ref : Ag / Agcl

◆ **Conductivity Sensor Signal Conditioning panel (CE6)**

[3 banana sockets]

- Consisting of 96 x 96 mm digital meter for conductivity display [4 digit], Range : 0 to 19.99 ms/cm.
- Connect to external conductivity sensor using BNC connector.
- Retransmission output : 4 to 20 mA.
- Aux. Supply needed : 230VAC/50Hz.
- *Conductivity Sensor supplied:*
  - MOC of Electrode : Platinum / glass, Lab grade
  - Maximum Operating Pressure : 2.5 Bar.

◆ **PC (P4/XP/WIN7/8/10/FAT32) based multi PID controller Software (PC not in scope of supply but P4/XP/WIN7/8/10 with parallel /USB port needed)**

- **Online monitoring / Data acquisition / PID Software**
  - On Installable (CD) works under XP, WIN7/8/10. PC with parallel port / USB needed.
  - Multiple PID Controllers limited only by Hardware Port availability.
  - Channel/IO setting is multi inputs multi outputs [MIMO].
  - RS485 [MODBUS] interface provided using USB to serial converter cable.

- **Operating modes**

a) **Graph Plotting :**

   1] Process Monitoring Mode :

   Draw graphs of time series, XY cartesian, Polar, burst mode provided with multiple channels including MODBUS & multiple graphs. Cursors for X & Y axis for meaurement & online graphs saving for reproduction.

   2] BOM Mode :

   Draw graph of time series of single channel with 1KHz frequency rate.

b) **PID controller Mode**

- PID controller with parameter like Integral Time Ti (0.01-64000), Sampling Time Ts(0.1-99.9), Derivative Time Td(0-99.9), Proportional Band Pb(1-999), Derivative Gain Kd(1-999), Set Value Rn(0-99.9), PID output Upper Limit Uh(0-99.9), PID output Lower Limit Ul (0-99.9).

- Facility to set units for output viz. (%) °C , RPM, V, mm, LPH, kg/cm^2, si/cm, Degree optionally experiments with advance process control scheme viz; Ratio, Cascade, feed forward with Aux PID, Ratio station & FF transfer function calculator, Alarm setting, ON/OFF control, square root extractor for Orifice.

- **Function Generator** : Sine / Triangular / Square wave generator with frequency 0.01 Hz to 1 Hz, Amplitude is 0 to 2.5 V i.e. 0 - 100%

Setup Specifications:

Process Loops [Parameters]	PH / Conductivity Control (Model : XPO- Chem-PCT)
Controlled Medium	Tap Water to be dosed with base and Acid solutions
Sump/Storage tank capacity	a) Acid storage tank, 1.5 Ltr. b) Base storage tank, 1.5 Ltr. made of cylindrical acrylic material both solutions to be added continuously using dosing pump into the reaction tank containing tap water of 4 liter to begin with. Replace the mixed water with fresh tap water at the end of experiment.
Process / Reaction tank capacity / material)	Process [Reaction] Tank 6 Litre , Acrylic Material, Stirrer for mixing acid or base with water.
Electric sensor Type/output Range	pH and conductivity sensors mounted on the process tank, mili volt output, connects to above signal conditioning panel using BNC connector to output 4-20 mA each.
Control Element	Chemical dosing pumps 2 No. for acid & base chemical one each, Flow rate : 2.88 LPH max., Pressure : 8.00 kg/cm^2, Power : 230V, 55W, 1 Ph. Control Input : 4 to 20 mA ,supplied with 2 foot valves to be dipped into chemical storage tanks for suction.
Drain valves	½" SS316 manual valves (2 Nos.)
Piping material/size	Teflon PU 6 x 4 for acid and base
Mech. Size/weight	1165(L) X 300(W) X 990(H)mm / 38 kg.
List of Experiments	1) pH Control Experiment 2) Conductivity Control Experiment
Optional	PLC interface will be provided

Control Engineering, Sensor/Transducer, Process Control, Instrumentation, Bio-Medical Engineering

PROCESS CONTROL TRAINER

4 Tank System (Model : XPO-PCT/4T)

SALIENT FEATURES

- Lightweight, yet sturdy, tabletop, Aluminium profile flat panel setup, with SS (304/316) piping for and wide angle view of every component in process. No hidden parts.
- Individual control loops as well as Advance control schemes like SISO, MIMO, **coupled tank** made easy for student.
- Connection through polarized FRC connectors, sturdy 4mm Banana sockets & Patch cords enabling quick setting up of variety of process control experiments.
- P4/XP / win 7 window based PID controller **(DDC)** software package with P, PI & PID control, Ratio & cascade control, three operating modes, Online graph drawing & data acquisition modes **(SCADA)**. PC not in scope of supply
- Option to implement MIMO strategy using MATLAB enabled interface, SDK for MATLAB.dll provided.
- Useful for Post Graduate projects and research purpose. Student Workbook and Instructors Guide supplied.

Technical Specifications (Controller Section)

◆ Computer Interface panel (CIPII)

- Connects to PC (WIN7/8/10) parallel port through 25 pin M to F cable / 1.5mtr.
- 8 ADC channels I/P: 0 to 2.5V FS with 1 no. input simulation pot. 2 DAC channel O/P 2.5V FS.
- V to I function block: I/P 0 to 2.5V & O/P 0-20 or 4-20mA (100 ohm load) switch settable.
- I to V function block : I/P 4 to 20mA & O/P 0 - 2.5V
- USB converter to interface 25 pin D connector on CIP panel to USB enclosed in 25 Pin D shell using Type A to mini B cable.

◆ Instrumentation Power supply cum Multichannel DPM panel (EMT 8)

- .DC Multi Output power supply.
- Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.
- Multi channel DPM for digital display of process parameters.
- 20 pin FRC power bus to supply power to neighboring panels.

◆ Thyristor Actuator cum signal conditioning panel (TAP) EMT-9/ CE2 x 3 Nos.

- Thyristor bridge based 0-200V/3A using cosine firing circuit, I/P 0 to 2.5Vdc.
- Supports signal conditioning for level sensor with Instrumentation Amplifier & Flow Sensor (Water / Air) with F to V converter to generate 0-2.5Vdc (FS).

◆ PC (WIN7/8/10/FAT32) based multi PID controller Software (PC not in scope of supply but P4/XP/WIN7 with parallel /USB port needed)

● Online monitoring / Data acquisition / PID Software

- On Installable (CD) works under XP, WIN7/8/10. PC with parallel port / USB needed.

- Multiple PID Controllers limited only by Hardware Port availability.
- Channel/IO setting is multi inputs multi outputs [MIMO].
- RS485 [MODBUS] interface provided using USB to serial converter cable.

● Operating modes

a) Graph Plotting :

1] Process Monitoring Mode :

Draw graphs of time series, XY cartesian, Polar, burst mode provided with multiple channels including MODBUS & multiple graphs. Cursors for X & Y axis for meaurement & online graphs saving for reproduction.

2] BOM Mode :

Draw graph of time series of single channel with 1KHz frequency rate.

b) PID controller Mode

- PID controller with parameter like Integral Time Ti (0.01-64000), Sampling Time Ts(0.1-99.9), Derivative Time Td(0-99.9), Proportional Band Pb(1-999), Derivative Gain Kd(1-999), Set Value Rn(0-99.9), PID output Upper Limit Uh(0-99.9), PID output Lower Limit Ul (0-99.9).
- Facility to set units for output viz. (%) °C , RPM, V, mm, LPH, kg/cm², msi/cm, Degree optionally experiments with advance process control scheme viz; Ratio, Cascade, feed forward with Aux PID, Ratio station & FF transfer function calculator, Alarm setting, ON/OFF control, square root extractor for Orifice.
- **Function Generator** : Sine / Triangular / Square wave generator with frequency 0.01 Hz to 1 Hz, Amplitude is 0 to 2.5 V i.e. 0 - 100%

210608

Setup Specifications :

Parameters	Four Tank System (Model : XPO- PCT-4T)
Controlled Medium	Water
Sump/Storage tank capacity	1 No. 50 litre Plastic PVC
Process tank capacity/ material	4 nos. of cylindrical plexiglass material made process tank 1.5 liter each with one drain outlet and one Air bubbler inlet.
Electric sensor Type / output Range	4 nos. of Level WC Pressure Sensor 0 - 200mm, Level Measurement by Bubbler method, Signal conditioned Output 0 - 2.5V.
Control Elements	• 2 Nos. of variable speed motorized centrifugal pumps driven from EMT9 (2Nos.) Panel I/P 0 to 2.5V, O/P 0 to 195VDC,Pump Speed = 0 to 2800 RPM • 3 Port Control Valves : 2 Nos. of 3 way pneumatically operated CV's air to close/air to open, 2 nos. of output ports, linear type ½" size diaphragm operated CV=0.4 with I to P converter I/P 4 to 20mA O/P 3 to 15 Psi.
Rotameter	2 Nos., Acrylic body ½ inch size, 0 - 200 LPH.
Generaton & Distribution Pump	1 No. 0.62KW, 1/12 HP, 2800 RPM, ½" outlet, 500 LPH, Head 9 meters with brass impeller.
Bourden Gauges	0 - 600 mm Water Column x 4 Nos., Pressure gauges 0 - 2.5 kg / cm^2 x 3 Nos.
Manual SS valves Piping Material/Size	½" Size 10 Nos., ¼" Size 2 Nos., Stainless steel, ½" for water, ¼" for air.
Air Filter & Regulators or Accessories	5 Nos., 0 - 10 bar Size ¼", Oil catcher (¼" Size Max. pressure 10 bar) - 1 No.
Air Compressor	0 - 7 bar, ½ HP, 230VAC supply (Optional)
Mech. Size/Weight	1165(L) X 300(W) X 990(H)mm / 38 kg.
List of Experiments	1) First order SISO, 2) MIMO Non interactive, 3) MIMO Interactive 4) Matlab based control.
Optional	PLC based controller can be provided needs to purchase XPO-PLC trainer separately.

Air Compressor (10 Bar) ⟶

USB to IO converter cable ⟶