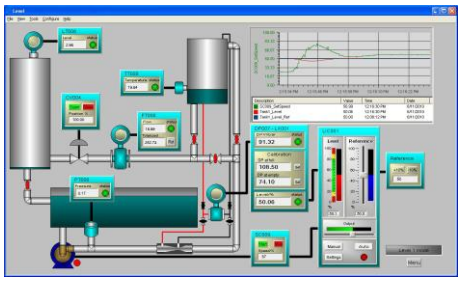
BYTRONIC
Educational Technology

Process Control and Instrumentation Technology PCT-200

Key Features:

- Meeting the demands for Cyber Physical Systems, IoT and Industry 4.0
- Complete self-contained floor standing unit fitted with wheels for mobility
- Complete with PLC and SCADA software easily connected to the PC using an Ethernet connection
- Clear Tanks and Pipes permit the process in the system to be clearly observed
- Industrial Instruments, Actuators and Sensors
- Calibration and Monitoring of Transmitters and Control Valve



The PCT-200 Process Control and Instrumentation unit is a fully integrated, fully equipped, self-contained floor standing process control system, representative of industrial process control systems used in many industries such as chemical, oil, food, water, power and other process industries. The PCT-200 is fitted with state-of-the-art intelligent process instruments and actuators networked using Fieldbus technology meeting the requirements for Industry 4.0. The system is available with choice of Fieldbus; PROFIBUS, PROFINET, ETHERNET and others, as required. The unit is supplied with all necessary controllers and software, including PLC, PLC programming software and SCADA software. Siemens and Allen Bradley PLCs are available, and others can be supplied on request.

The PCT-200 can be configured to implement different control strategies for flow and level control using cascade, feed-forward and multi-variable strategies, separate level alarms and process and device temperature monitoring. Control of the system is through SCADA (Supervisory Control and Data Acquisition) software using a PC with an Ethernet connection.

The PCT-200 is fitted with clear tanks, pipes and industrial instruments, actuators and sensors. Labworks cover; Instrument set-up and calibration, actuator elements and characteristics, feedback control systems, fieldbus systems, Ethernet and LAN technology.

Water is pumped around the system using a speed-controlled three-phase pump, controlled by a variable frequency inverter, from a reservoir tank to two process tanks. The pump outflow goes through a venturi-tube providing flow measurement using a differential pressure transmitter. A pressure transmitter is used to measure the discharge pressure from the pump and can be used for experiments on the pump characteristics. Manual ball valves can be set to direct the flow around the system. The level in process tank one can be measured using the differential pressure transmitter, and in process tank two, using the ultrasonic level transmitter. A temperature transmitter is fitted in process tank one for monitoring of the water temperature.

The outlets of process tank one from the reservoir tank goes to process tank two through an electromagnetic flow meter and then to a modulating control valve fitted with a pneumatic positioner. The control valve can be used in conjunction with the flow transmitter for flow control, or in conjunction with the ultrasonic level transmitter for level control in process tank two. A cascade control system can also be implemented by feeding the level controller output as a set-point to the flow controller.

Curriculum Content and Labworks

Instrument Setup and Calibration

a. Temperature measurement
   i. Temperature measurement and status indication
   ii. Scale and alarm limit setting, simulation mode for intelligent sensors.

b. Sensor and transmitter diagnostics. Level measurement
   i. Hydrostatic level measurement and calibration, effects of density.
   ii. Ultrasonic level measurement and calibration.
   iii. Ultrasonic reflection envelope curve and problem diagnosis.

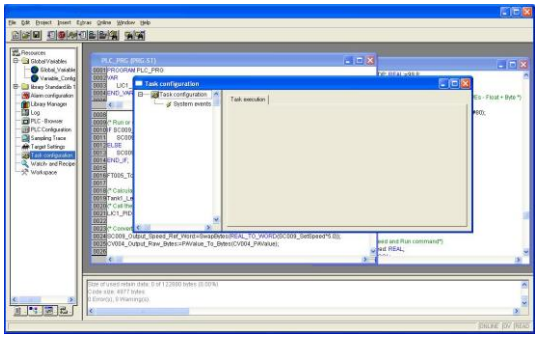
c. Flow measurement
   i. Volume and mass flow measurement using electromagnetic flow meter.
   ii. Flow meter calibration.
   iii. Flow rate measurement using a differential pressure transmitter and orifice plate.
   iv. Square root extraction within an intelligent transmitter.
   v. Calibration and performance of a head meter.
   vi. Process noise in flow measurement.

Instrument Monitoring and Calibration

Actuation Elements and Characteristics

d. Control valve
   i. Valve positioner operation and calibration.
   ii. Valve sizing calculation and verification.
   iii. Measurement of valve installed characteristic.
   iv. Fail-safe action in the event of pneumatic or electronic failure.

e. Inverter, Motor and Centrifugal pump
   i. Induction motor speed control and characteristics
   ii. Setting up a drive over Fieldbus.
   iii. Centrifugal pump speed/flow/head characteristic measurement.



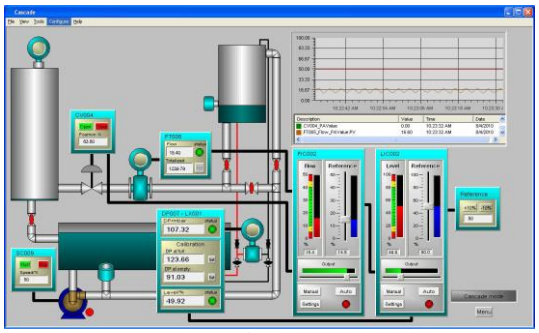
PLC Programming Software

Feedback Control Systems

f. Level control
   i. Control of level using variable pump speed.
   ii. Control of level using control valve.
   iii. P, PI and PID level controller tuning and performance.

g. Flow control
   i. Flow control using variable pump speed.
   ii. Flow control using a control valve.
   iii. P, PI and PID controller tuning and performance.

h. Cascade and feed-forward control
   i. Cascade control of level and flow
   ii. Feed-forward control using flow measurement
   iii. Multi-variable control of level and flow

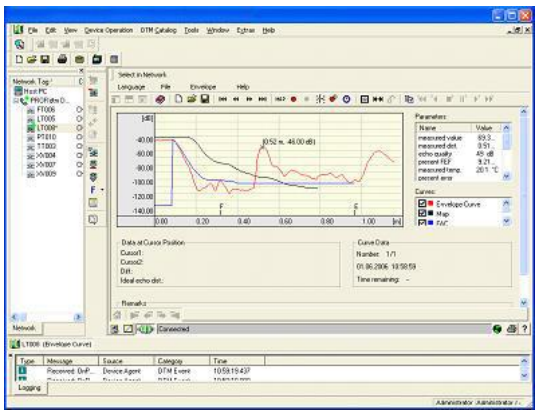


SCADA Software – Cascade

Fieldbus Systems

i. Fieldbus system configuration for cyclic data
   i. Basic device configuration, GSD files, modules and parameters.
   ii. Bit-rate selection and cycle time effects.
   iii. Process system configuration, process value and status byte handling.
   iv. Diagnostics, watchdog timer setting and fail-safe action.

j. Acyclic communications
   i. Use of engineering tools with acyclic communication capability.
   ii. Device profiles: physical, transducer and function blocks
   iii. Methods of device calibration using acyclic communications
   iv. Advanced device diagnostics and status
   v. Auto, manual and simulation modes of operation for transmitters and actuators.
   vi. Predictive maintenance features in a modern control valve positioner
   vii. Predictive maintenance features in a modern inverter.



Instrument Control Software

Ethernet and LAN Technology

k. Network configuration and checking
   i. MAC and IP addressing, setup and checking
   ii. PC networking diagnostic facilities.
   iii. Remote device configuration using http (web) technology.

Process Unit

Tanks	
Reservoir Tank	54 Litres approximately
Process Tank 1	37 Litres approximately
Process Tank 2	21 Litres approximately
Pipes	1-inch clear UPVC
Rated working pressure of piping	15.2 bar, giving a safety factor of ≃ 10.
Flow Rate around the system	Nominal maximum flow rate 20 Litre per minute
Pump	Three Phase, 0.37KW Flow rate up to 40 Litres per minute Head up to 40Meters
Linear flow/head and flow/speed characteristics	At a speed of 2900rpm (50Hz) Maximum Head of 16m (~1.6bar) at zero 2m at 16 Litre per minute
Flow Transducer	Electromagnetic flow meter Bidirectional measurement of liquids with a minimum conductivity of ≥ 5 µS/cm
Maximum measured Error	Pulse output: ± 0.5% o.r. ± 1mm/s (o.r. = of reading) Current output: plus typically ± 5µA
Pressure Transducer	
Measuring Ranges	Up to 400bar
Output	4 to 20mA
Ultrasonic Transducer	
Maximum measuring range:	5m in fluids / 2m in bulk materials Integrated temperature sensor for automatic correction of the temperature dependent sound velocity
Temperature Transducer	Pt100 sensing element with class A accuracy
DP Cell Measuring Ranges	From –10...+10mbar to –40...+40bar
Control Valve	2/2–way globe control valve with electronic control of positioning provides flow measurement for the pump delivery.
Venturi	Clear Acrylic. The maximum differential at a flow rate of 16 litre/min is 0.6m, the overall loss 0.1m.
Motor Control Inverter	250V AC 1.1KW

Ordering Information

Model Number: PCT-200

Consists of:

PCT-200 Process Control and Instrumentation rig floor standing;
constructed from 40 x 40mm Aluminium Profile Frame, 1-inch clear PVC Pipes and clear PVC tanks

- Control cabinet with window
- Venturi tube
- Three Phase pump
- Pressure regulator with gauge
- Manual control valves
- Curriculum manual and CD
- Three Phase inverter
- Fieldbus coupler
- PLC programming software
- Ethernet gateway
- Ethernet switch
- Asset management software
- Ultrasonic Level Transmitter
- Temperature Transmitter
- Differential Pressure Transmitter
- Electromagnetic Flow Meter
- Pressure Transmitter
- Global control valve with Positioner

Required

Air Supply required: - 6 Bar continuous supply Mains supply required: - 240v AC Single Phase

A suitable PC with Minimum; Pentium processor, 1GB RAM, 20GB HDD, CDROM Drive, USB 2 interface and Windows OS.

Weights and Dimensions

Un-Packed		**Packed**	
Dimensions (cm)	176 L x 70 W x 195 H	Dimensions (cm)	192 L x 88 W x 218 H
Weight	150kg	Weight	320kgs (Tarre weight 170 kgs)

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