# Computer Controlled **Aerobic Digester,**
## with SCADA and PID Control

## PDAC

**Engineering and Technical Teaching Equipment**

EDIBON **SCADA** System and **PID Control** included

Teaching Technique used

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

⑤ Cables and Accessories

⑥ Manuals

Computer (not included in the supply)

**\* Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6**
(Computer not included in the supply)

① Unit: PDAC. Computer Controlled Aerobic Digester

Key features:

➤ **Advanced Real-Time SCADA and PID Control.**

➤ **Open Control + Multicontrol + Real-Time Control.**

➤ **Specialized EDIBON Control Software based on LabVIEW.**

➤ **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**

➤ **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**

➤ **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**

➤ **Capable of doing applied research, real industrial simulation, training courses, etc.**

➤ **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**

➤ **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**

➤ **Designed and manufactured under several quality standards.**

➤ **Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**

➤ **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

**OPEN CONTROL**
**+**
**MULTICONTROL**
**+**
**REAL TIME CONTROL**

POWERED BY
NATIONAL INSTRUMENTS
**LabVIEW™**

**www.edibon.com**
⤷PRODUCTS
⤷13.-ENVIRONMENT

For more information about Key Features, click here

# INTRODUCTION

The first step to which residual water is subjected when entering a Sewage Farm is a pretreatment. Big solids, sand and grease are removed.

Next, water undergoes the so-called primary treatment. Easily settled suspended solids and part of the organic matter are removed.

The rest of organic matter, dissolved and suspended, and the rest of solid particles that have not been removed in previous treatments are removed by the so-called "Aerobic Wastewater Treatment Biological Processes", which is the secondary treatment of the water line.

The "Aerobic Wastewater Treatment Biological Processes" can be defined as those processes carried out by a specific group of microorganisms that in presence of oxygen act on the dissolved, suspended and colloid organic and inorganic matter existing in wastewater. They transform that matter into gases and cells that can be easily separated by settling.

# GENERAL DESCRIPTION

The objective of the Computer Controlled Aerobic Digester, "PDAC", unit is to study and understand aerobic digestion processes and to analyze their main parameters.

The unit consists of a 20 l capacity reactor vessel with a tubular membrane made of plastic inside to separate the sludge. Wastewater to be treated enters the vessels pumped by a peristaltic pump.
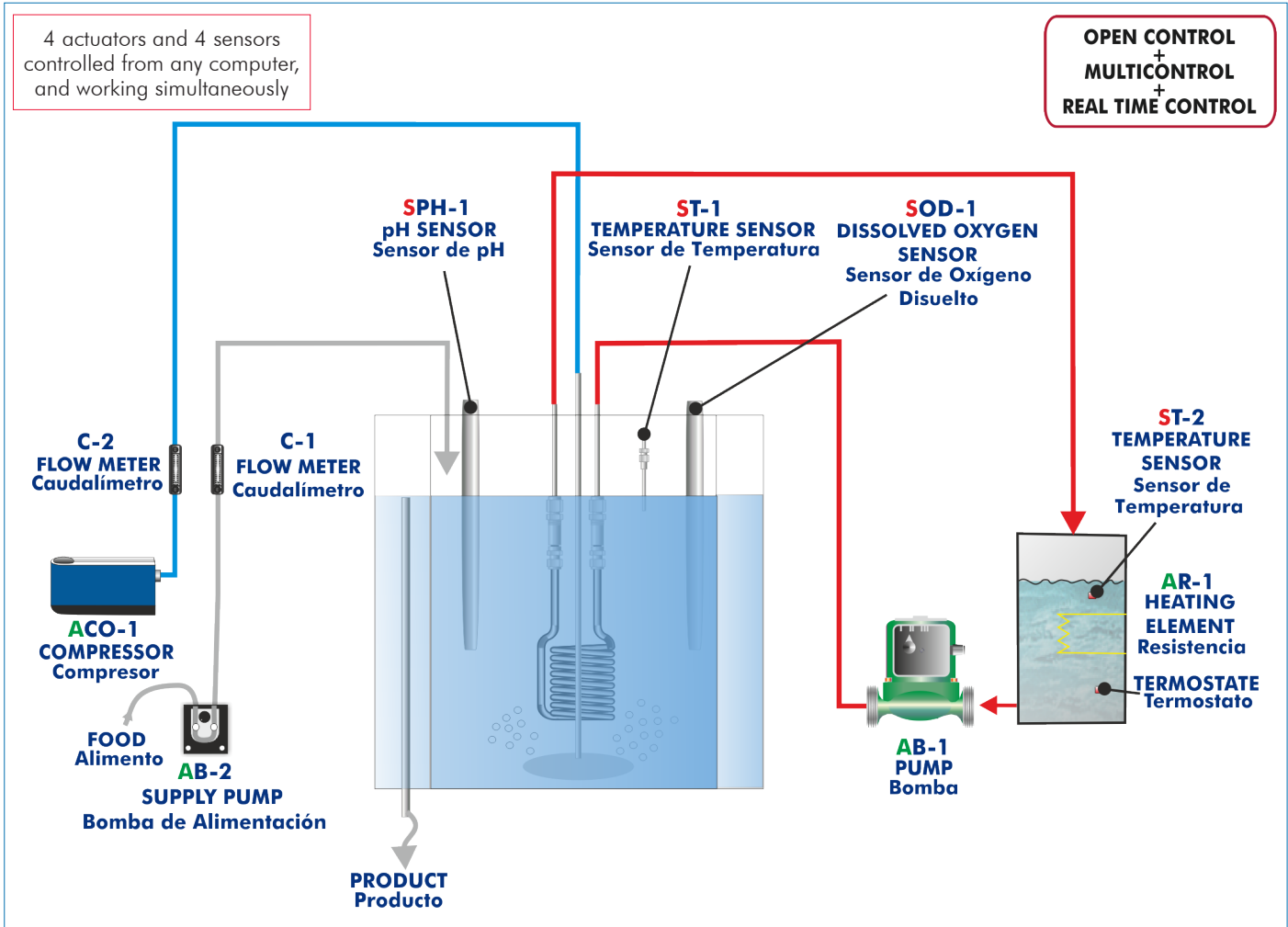
This unit includes a computer controlled thermostatic bath to heat water up to 60 °C. That water is driven by a pump through a coil inside the reactor. A suitable temperature for the microorganisms population employed in the aerobic digestion will be obtained.

The greater amount of oxygen available in the environment in the aerobic digestion, the quicker the bacteria involved in the process will grow. Therefore, a compressor introduces a specific air flow into the reactor through a diffusion plate.

The aerobic reactor includes a temperature, pH and dissolved oxygen sensor to monitor the digestion.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

# PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

4 actuators and 4 sensors controlled from any computer, and working simultaneously

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

SPH-1
pH SENSOR
Sensor de pH

ST-1
TEMPERATURE SENSOR
Sensor de Temperatura

SOD-1
DISSOLVED OXYGEN SENSOR
Sensor de Oxígeno Disuelto

ST-2
TEMPERATURE SENSOR
Sensor de Temperatura

C-2
FLOW METER
Caudalímetro

C-1
FLOW METER
Caudalímetro

AR-1
HEATING ELEMENT
Resistencia

TERMOSTATE
Termostato

ACO-1
COMPRESSOR
Compresor

FOOD
Alimento

AB-2
SUPPLY PUMP
Bomba de Alimentación

AB-1
PUMP
Bomba

PRODUCT
Producto

With this unit there are several options and possibilities:
- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9 and 10.
Let us describe first the main items (1 to 6):

① **PDAC. Unit:**

Bench-top unit.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

Diagram in the front panel with distribution of the elements similar to the real one.

20 l reactor vessel with a tubular membrane inside.

Lid for the reactor with a manual valve and the respective holes.

Heating or cooling coil.

Thermostatic bath (up to 60 °C), computer controlled (PID control):

　　6 l capacity.

　　Power: 600 W.

Temperature sensor "J" type to obtain the temperature in the thermostatic bath.

Pump for hot water circulation of the thermostatic bath, computer controlled.

Air compressor, range: 0 – 5 l/min, computer controlled.

Diffusion plate for the air inlet.

Air flow meter, range: 0.4 – 5 l/min.

Peristaltic pump, range: 0 – 0.05 l/min, computer controlled.

Water flow meter, range: 0.004 – 0.05 l/min.

Membrane, muds separation.

Overflow for the outlet of filtered water.

Valve on the bottom for mud extraction.

To monitor the digestion:

　　Temperature sensor.

　　pH sensor.

　　Dissolved oxygen sensor.

The complete unit includes as well:

　　Advanced Real-Time SCADA and PID Control.

　　Open Control + Multicontrol + Real-Time Control.

　　Specialized EDIBON Control Software based on LabVIEW.

　　National Instruments Data Acquisition board (250 KS/s, kilo samples per second).

　　Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.

　　Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

　　Capable of doing applied research, real industrial simulation, training courses, etc.

　　Remote operation and control by the user and remote control for EDIBON technical support, are always included.

　　Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

　　Designed and manufactured under several quality standards.

　　Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.

　　This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.



Unit: PDAC

**② PDAC/CIB. Control Interface Box:**

The Control Interface Box is part of the SCADA system.

<u>Control interface box with process diagram in the front panel</u> and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated from -10V. to +10V. computer output.

Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.

Single cable between the control interface box and computer.

**The unit control elements are permanently computer controlled,** without necessity of changes or connections during the whole process test procedure.

**Simultaneous visualization in the computer of all parameters involved in the process.**

**Calibration of all sensors involved in the process.**

**Real time curves representation about system responses.**

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/system responses.

**All the actuators' values can be changed at any time from the keyboard** allowing the analysis about curves and responses of the whole process.

All the actuators and sensors values and their responses are displayed on only one screen in the computer.

**Shield and filtered signals to avoid external interferences.**

**Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process.**

Real time PID and on/off control for pumps, compressors, heating elements, control valves, etc.

**Real time PID control for parameters involved in the process simultaneously.**

**Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time,** of the three control constants (proportional, integral and derivative constants).

**Open control** allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.

Possibility of automatization of the actuators involved in the process.

**Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.**
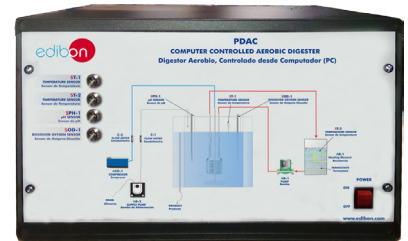
PDAC/CIB

**③ DAB. Data Acquisition Board:**

The Data Acquisition board is part of the SCADA system.

**PCI Express Data acquisition board (National Instruments)** to be placed in a computer slot. Bus PCI Express.

Analog input:

Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.

**Sampling rate up to: 250 KS/s (kilo samples per second).**

Input range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

Analog output:

Number of **channels=2. Resolution=16 bits**, 1 in 65536.

Maximum output rate up to: 900 KS/s.

Output range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **channels=24 inputs/outputs**. D0 or DI Sample Clock frequency: 0 to 100 MHz.

Timing: Number of **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

**The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.**

DAB

**④ PDAC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software:**

The three softwares are part of the SCADA system.

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.**

Registration and visualization of all process variables in an automatic and simultaneous way.

**Flexible, open and multicontrol software**, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

**Sampling velocity up to 250 KS/s (kilo samples per second).**

Calibration system for the sensors involved in the process.

**It allows the registration of the alarms state and the graphic representation in real time.**

Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

**Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords** to facilitate the teacher's control on the student, and allowing the access to different work levels.

**This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.**
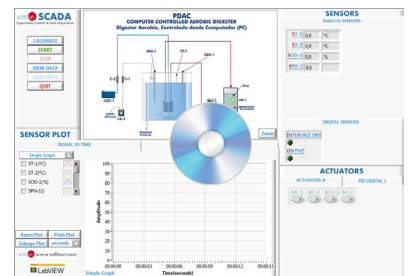
PDAC/CCSOF

**⑤ Cables and Accessories**, for normal operation.

**⑥ Manuals:**

This unit is **supplied with 8 manuals**: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

∗ References 1 to 6 are the main items: PDAC + PDAC/CIB + DAB + PDAC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

## EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

1.- Acclimation of biological samples.
2.- Study of the temperature effect on the effluent quality.
3.- Study of the detention time effect on the effluent quality.
4.- Study of the aireation effect on the effluent quality.
5.- Study of the pH effect on the effluent quality.
6.- Study of the mass load effect on the effluent quality.
7.- Study of the nutrients effect on the effluent quality.
8.- Study of the recirculation effect on the effluent quality.
9.- Establishing the stoichiometry of aerobic processes.
10.-Establishing the kinetics of aerobic processes.
11.-Gas/liquid mass transfer.
12.-Residence time distributions.
13.-Measurement of MLSS and COD changes as criteria of performance.

Additional practical possibilities:

14.-Sensors calibration.

Other possibilities to be done with this Unit:

15.-Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

16.-Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

17.-The Computer Control System with SCADA and PID Control allow a real industrial simulation.
18.-This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
19.-This unit can be used for doing applied research.
20.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
21.-Control of the PDAC unit process through the control interface box without the computer.
22.-Visualization of all the sensors values used in the PDAC unit process.
- Several other exercises can be done and designed by the user.

## REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.
- Computer.

## DIMENSIONS AND WEIGHTS

PDAC:
  Unit:
    - Dimensions: 800 x 600 x 700 mm approx.
                (31.50 x 23.62 x 27.56 inches approx.)
    - Weight:        50 Kg approx.
                (110 pounds approx.).
  Control Interface Box:
    - Dimensions: 490 x 330 x 310 mm approx.
                (19.29 x 12.99 x 12.20 inches approx.).
    - Weight:        10 Kg approx.
                (22 pounds approx.).

## ADDITIONAL RECOMMENDED ELEMENTS (Not included)

- Feed and product tanks (40 l approx.).

## SIMILAR UNITS AVAILABLE

Offered in this catalog:

- PDAC. Computer Controlled Aerobic Digester.

Offered in other catalogs:

- PDA. Aerobic Digester.
- PDAN. Anaerobic Digester.
- PDANC. Computer Controlled Anaerobic Digester.

### SCADA and PID Control
### Main screen
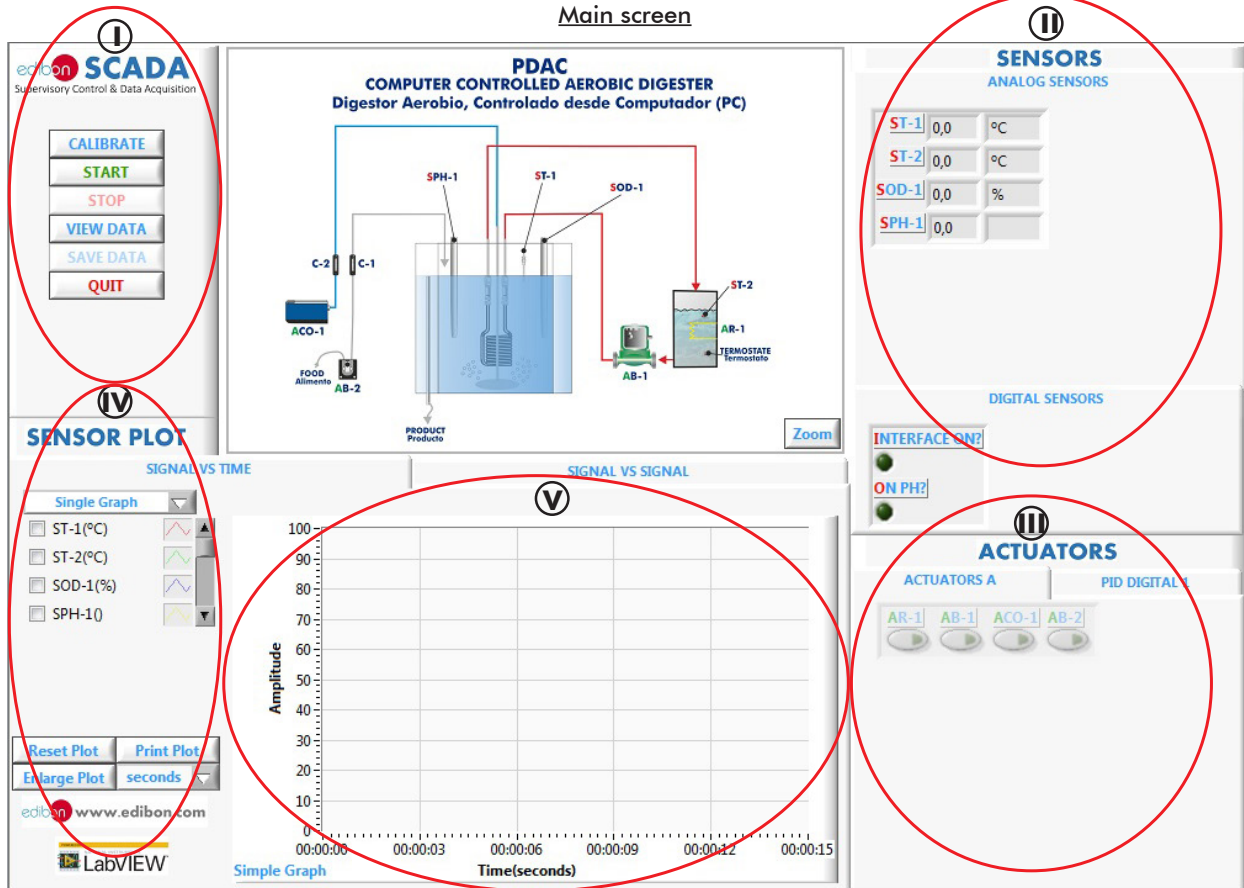


ⓘ Main software operation possibilities.

ⓘⓘ Sensors displays, real time values, and extra output parameters. **Sensors:** ST= Temperature sensor. SOD=Dissolved oxygen sensor. SPH=pH sensor.

ⓘⓘⓘ Actuators controls. **Actuators:** AB= Pump. AR=Heating element. ACO=Air compressor.

ⓘⓥ Channel selection and other plot parameters.

ⓥ Real time graphics displays.

### Software for Sensors Calibration
Example of screen
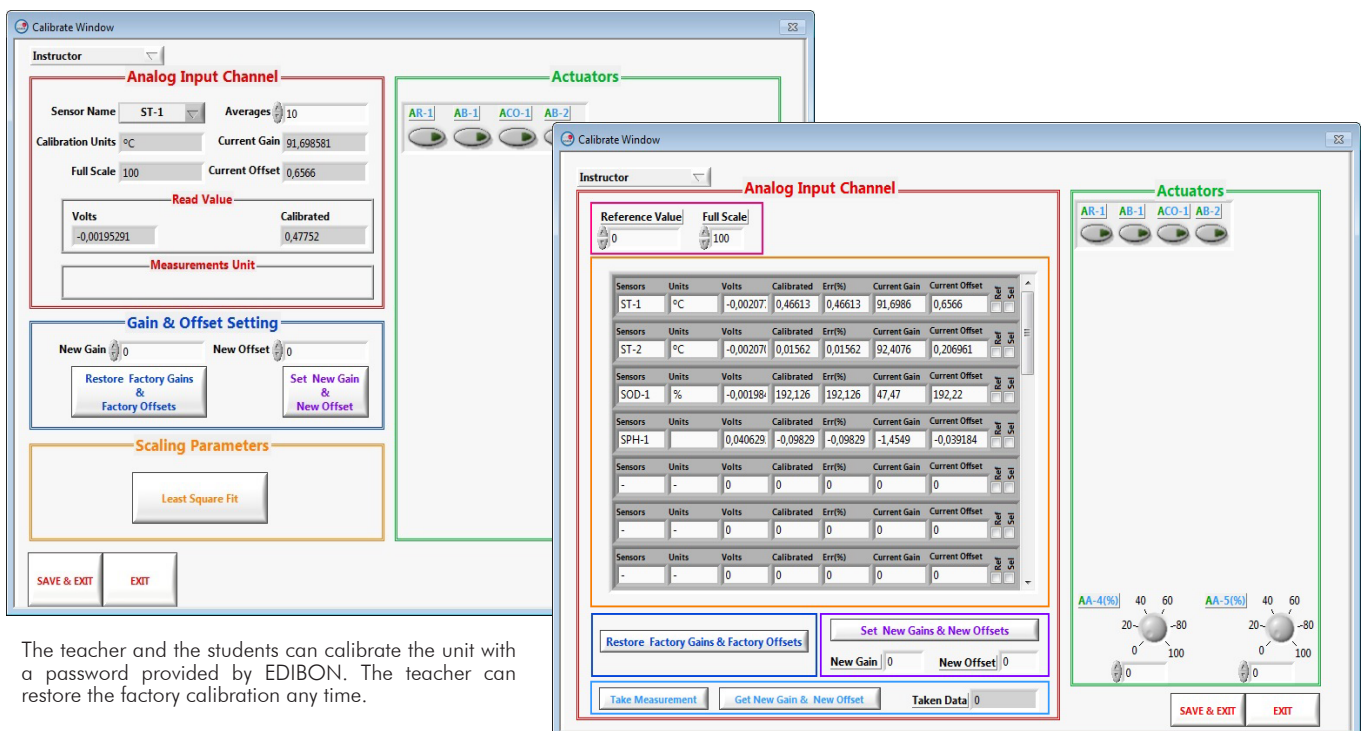


The teacher and the students can calibrate the unit with a password provided by EDIBON. The teacher can restore the factory calibration any time.

# SOME **REAL** RESULTS OBTAINED FROM THIS UNIT

Representation in real time of the measured magnitudes. Two graphs with temperature and dissolved oxigen measures.
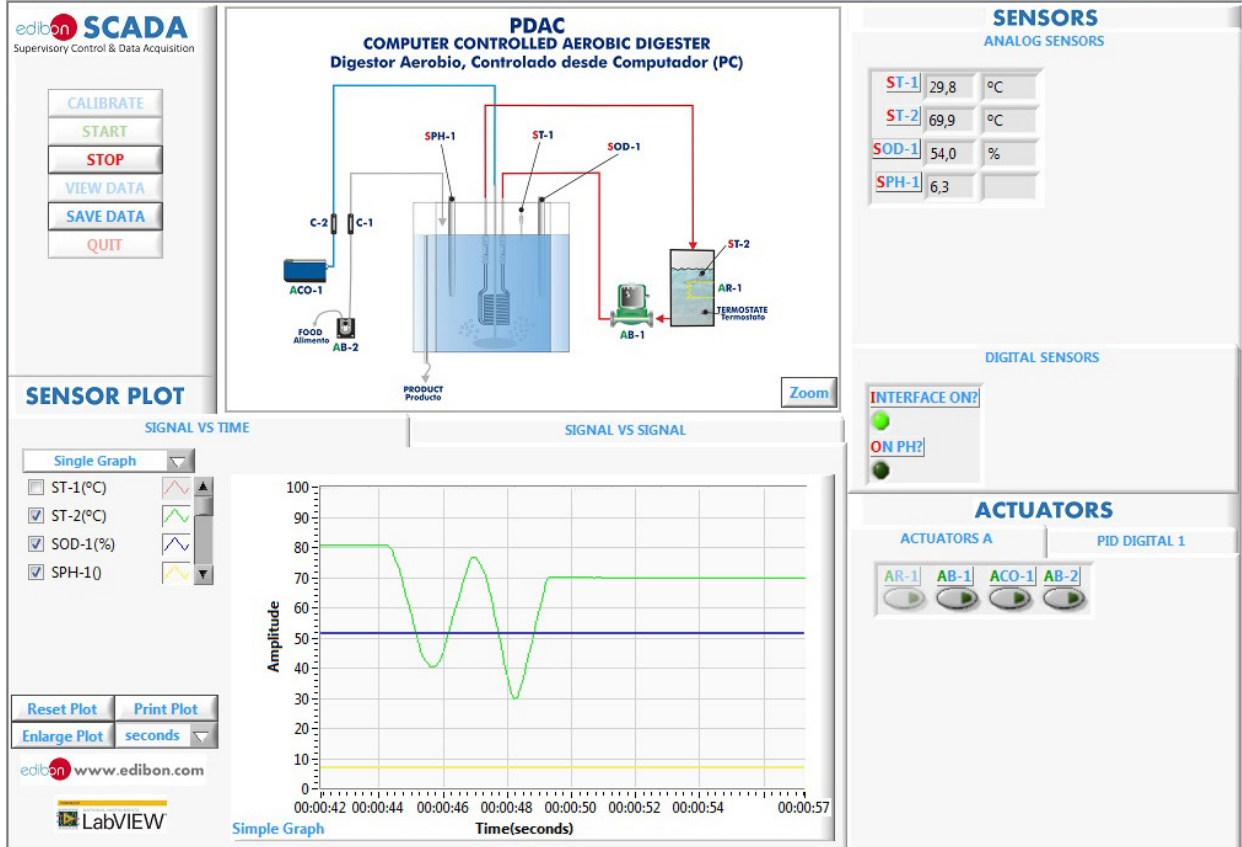


Heating temperature control is done through a PID control. When the target temperature is reached at the temperature sensor (ST-2), the heating element is turned off.

www.edibon.com
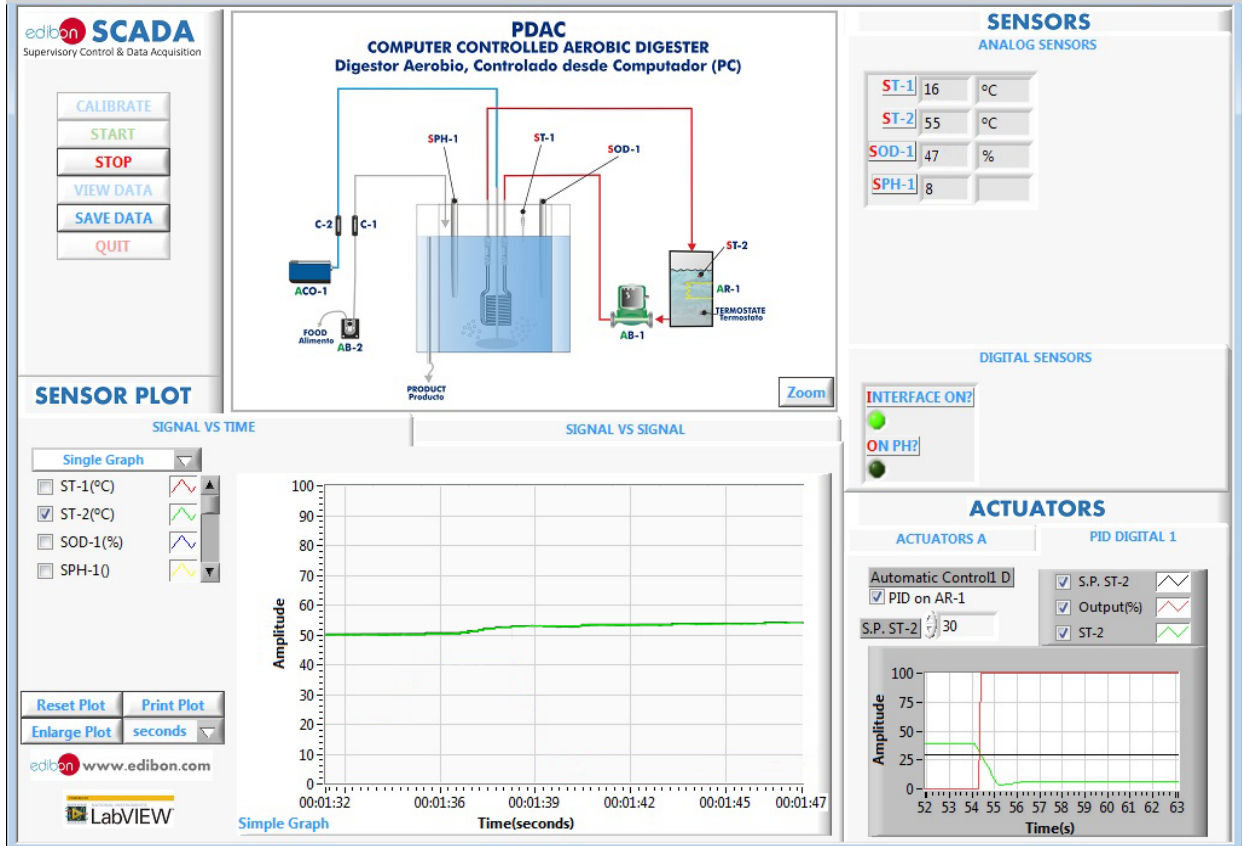
Some **real** results obtained from this Unit

Signal versus signal chart where any of the measured variables can be represented.

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 10.

All these items try to give more possibilities for:

    a) Technical and Vocational Education configuration. (ICAI and FSS)

    b) Multipost Expansions options. (MINI ESN and ESN)

## a) Technical and Vocational Education configuration

⑦ **PDAC/ICAI. Interactive Computer Aided Instruction Software.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

This software is optional and can be used additionally to items (1 to 6).

**Instructor Software**

**- ECM-SOF. EDIBON Classroom Manager (Instructor Software).**

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.



ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen

Innovative features:

- **User Data Base Management.**

- **Administration and assignment of Workgroup, Task and Training sessions.**

- **Creation and Integration of Practical Exercises and Multimedia Resources.**

- **Custom Design of Evaluation Methods.**

- **Creation and assignment of Formulas & Equations.**

- **Equation System Solver Engine.**

- **Updatable Contents.**

- **Report generation, User Progression Monitoring and Statistics.**



ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram



ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

**- ESL-SOF. EDIBON Student Labsoft (Student Software).**

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.
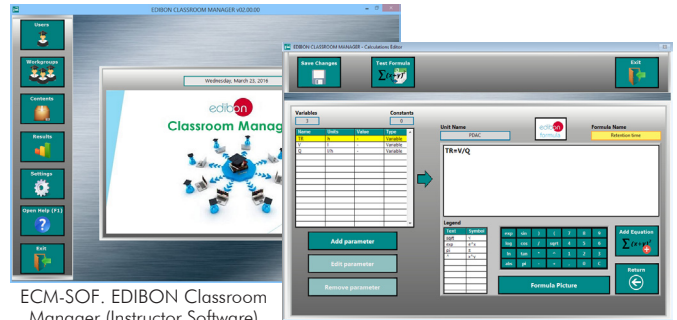
**Student Software**



ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen

Innovative features:

- **Student Log-In & Self-Registration.**

- **Existing Tasks checking & Monitoring.**

- **Default contents & scheduled tasks available to be used from the first session.**

- **Practical Exercises accomplishment by following the Manual provided by EDIBON.**

- **Evaluation Methods to prove your knowledge and progression.**

- **Test self-correction.**

- **Calculations computing and plotting.**

- **Equation System Solver Engine.**

- **User Monitoring Learning & Printable Reports.**

- **Multimedia-Supported auxiliary resources.**



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/en/files/expansion/ICAI/catalog

⑧ **PDAC/FSS. Faults Simulation System.**

Faults Simulation System (FSS) is a Software package that simulates **several faults** in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.
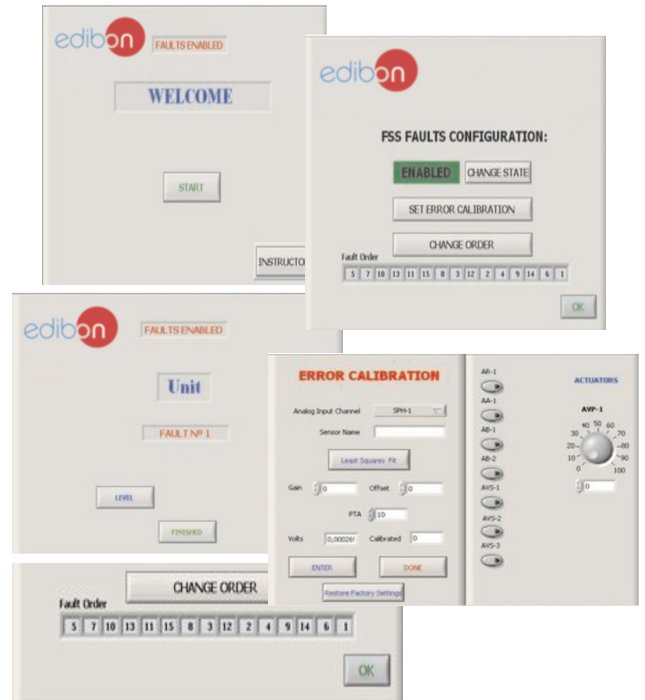
The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them. There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.

- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.

- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.

- Reduction or increase of the calculated total response.

- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

For more information see **FSS** catalogue. Click on the following link:

**www.edibon.com/en/files/expansion/FSS/catalog**

Example of some screens



b) Multipost Expansions options

⑨ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA and PID Control integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA and PID Control, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

For more information see **MINI ESN** catalogue. Click on the following link:

**www.edibon.com/en/files/expansion/MINI-ESN/catalog**

**MINI ESN.**
**EDIBON Mini Scada-Net System**



1 UNIT= up to 30 STUDENTS can work simultaneously

Computer Controlled Aerobic Digester (PDAC)

Control Interface Box

Software for:
- Computer Control
- Data Acquisition
- Data Management

Instructors' Central Computer

Mini Scada-Net Software

LOCAL NET FOR 30 STUDENTS

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL
+
MULTI STUDENT POST

**Note:** The MINI ESN system can be used with any EDIBON computer controlled unit

⑩ **ESN. EDIBON Scada-Net Systems.**

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.

For more information see **ESN** catalogue. Click on the following link:

**www.edibon.com/en/files/expansion/ESN/catalog**
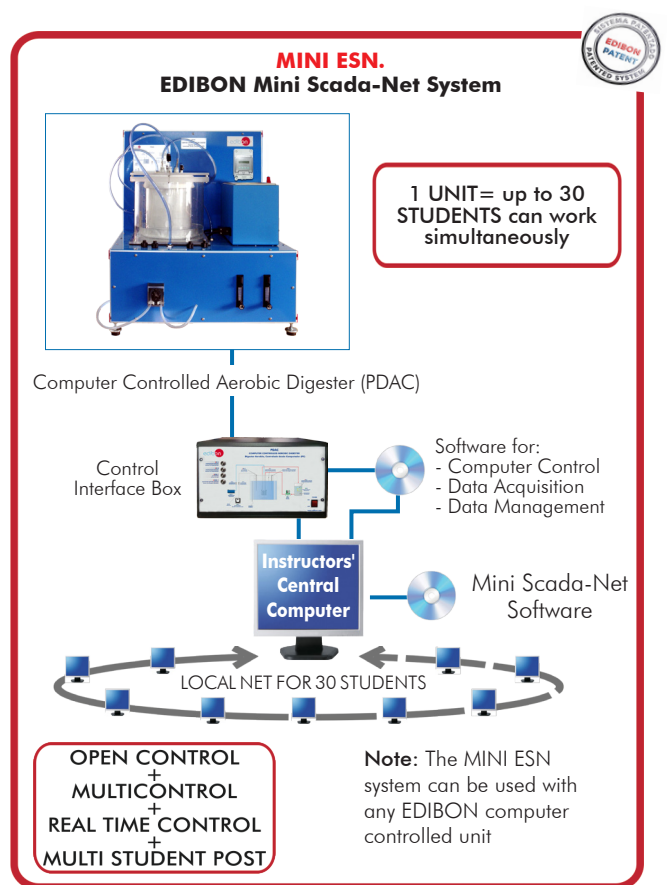
**Main items** (always included in the supply)

Minimum supply always includes:

① **Unit: PDAC. Computer Controlled Aerobic Digester.**

② **PDAC/CIB. Control Interface Box.**

③ **DAB. Data Acquisition Board.**

④ **PDAC/CCSOF. PID Computer Control + Data Acquisition + Data Management Software.**

⑤ **Cables and Accessories**, for normal operation.

⑥ **Manuals.**

*IMPORTANT: Under PDAC we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.

**Optional items** (supplied under specific order)

a) Technical and Vocational Education configuration

⑦ PDAC/ICAI. Interactive Computer Aided Instruction Software.

⑧ PDAC/FSS. Faults Simulation System.

b) Multipost Expansions options

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Analog output: Channels=2. Resolution=16 bits, 1 in 65536.
Digital Input/Output: Channels=24 inputs/outputs.
The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.

④**PDAC/CCSOF. PID Computer Control +Data Acquisition+Data Management Software:**
The three softwares are part of the SCADA system.
Compatible with the industry standards.
Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
Analog and digital PID control. PID menu and set point selection required in the whole work range.
Management, processing, comparison and storage of data.
Sampling velocity up to 250 KS/s (kilo samples per second).
Calibration system for the sensors involved in the process.
It allows the registration of the alarms state and the graphic representation in real time.
Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

⑤**Cables and Accessories**, for normal operation.

⑥**Manuals:**
This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

## Exercises and Practical Possibilities to be done with the Main Items

1.- Acclimation of biological samples.

2.- Study of the temperature effect on the effluent quality.

3.- Study of the detention time effect on the effluent quality.

4.- Study of the aireation effect on the effluent quality.

5.- Study of the pH effect on the effluent quality.

6.- Study of the mass load effect on the effluent quality.

7.- Study of the nutrients effect on the effluent quality.

8.- Study of the recirculation effect on the effluent quality.

9.- Establishing the stoichiometry of aerobic processes.

10.-Establishing the kinetics of aerobic processes.

11.-Gas/liquid mass transfer.

12.-Residence time distributions.

13.-Measurement of MLSS and COD changes as criteria of performance.

Additional practical possibilities:

14.-Sensors calibration.

Other possibilities to be done with this Unit:

15.-Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

16.-Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

17.-The Computer Control System with SCADA and PID Control allow a real industrial simulation.

18.-This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.

19.-This unit can be used for doing applied research.

20.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

21.-Control of the PDAC unit process through the control interface box without the computer.

22.-Visualization of all the sensors values used in the PDAC unit process.

- Several other exercises can be done and designed by the user.

**⑦ PDAC/ICAI. Interactive Computer Aided Instruction Software.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

• User Data Base Management.

• Administration and assignment of Workgroup, Task and Training sessions.

• Creation and Integration of Practical Exercises and Multimedia Resources.

• Custom Design of Evaluation Methods.

• Creation and assignment of Formulas & Equations.

• Equation System Solver Engine.

• Updatable Contents.

• Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

• Student Log-In & Self-Registration.

• Existing Tasks checking & Monitoring.

• Default contents & scheduled tasks available to be used from the first session.

• Practical Exercises accomplishment by following the Manual provided by EDIBON.

• Evaluation Methods to prove your knowledge and progression.

• Test self-correction.

• Calculations computing and plotting.

• Equation System Solver Engine.

• User Monitoring Learning & Printable Reports.

• Multimedia-Supported auxiliary resources.

**⑧ PDAC/FSS. Faults Simulation System.**

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.

- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.

- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.

- Reduction or increase of the calculated total response.

- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

Tender Specifications (for optional items)

b) Multipost Expansions options

⑨ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA and PID Control integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA and PID Control, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.

- Students' computers.

- Local Network.

- Unit-Control Interface adaptation.

- Unit Software adaptation.

- Webcam.

- MINI ESN Software to control the whole system.

- Cables and accessories required for a normal operation.

✱ Specifications subject to change without previous notice, due to the convenience of improvement of the product.

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