Computer Controlled **Biomedical Circulatory System Teaching Unit,** with SCADA and PID Control

BICSC

Teaching Technique used

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

① Unit: BICSC. Computer Controlled Biomedical Circulatory System Teaching Unit

② Control Interface Box

③ Data Acquisition Board

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

Computer
(not included in the supply)

⑤ Cables and Accessories

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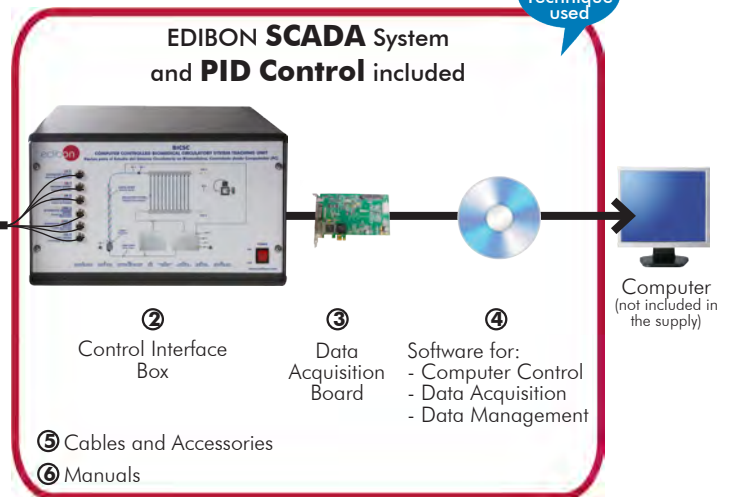
* Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6
(Computer not included in the supply)

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

LabVIEW™

www.edibon.com
↳PRODUCTS
↳14.-BIOMEDICAL ENGINEERING

For more information about Key Features, click here

INTRODUCTION

Blood is a fluid that contains nutrients, oxygen, carbon dioxide, hormones and blood cells, and transports them to the cells in the body. This means that blood, and consequently the circulatory system, is in charge of providing nutrients, fighting diseases and maintaining homeostasis and temperature in all the cells in the body.

There are many variables to consider when analyzing blood, e.g. red blood cell count, erythrocyte sedimentation rate, bilirubin concentration, etc. However, there are two especially important variables: the blood flow (studied by hemodynamics), which helps in the diagnosis of circulatory problems such as atherosclerosis or clotting; and the viscosity, whose differences may signal anemia or hypothermia.

The Computer Controlled Biomedical Circulatory System Teaching Unit, "BICSC", allows the user to simulate different circulatory pathologies with a series of tubes (simulating arteries), several pressure sensors and a viscometer. Besides, a digital blood pressure monitor is included to study its operation.

GENERAL DESCRIPTION

The Computer Controlled Biomedical Circulatory System Teaching Unit, "BICSC", allows the students to learn how to interpret the results obtained by the viscometer and pressure sensors, and apply them for the diagnosis of circulatory problems.

The unit has two tanks: one for water and the other for a fluid of viscosity similar to blood.

A computer controlled heating element varied the temperature of the fluid (PID Control).

A computer controlled pump simulates the function of the heart, impelling fuid selected from the tank, through a pipe that simulates the vena cava and another pipe of greater diameter that represents the aorta towards a network of tubes (arteries).

There is a pressure sensor in this pipe (aorta) that provides a representative measurement of both the diastolic and systolic slood pressure.

The aorta artery ends in a network of pipes that simulate the arteries that communicate the blood with the different parts of the human body. In this point there are two pressure sensors, used to take measures before and after the arteries and study the pressure drop in them.

Finally, the fluid leaving the circuit of arteries discharges again in the storage tanks.

BICSC detail

In addition, a digital blood pressure monitor connected to a pressure sensor, is included to take blood pressure measurements and collect pressure changes.

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.
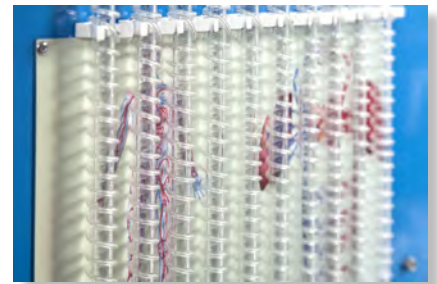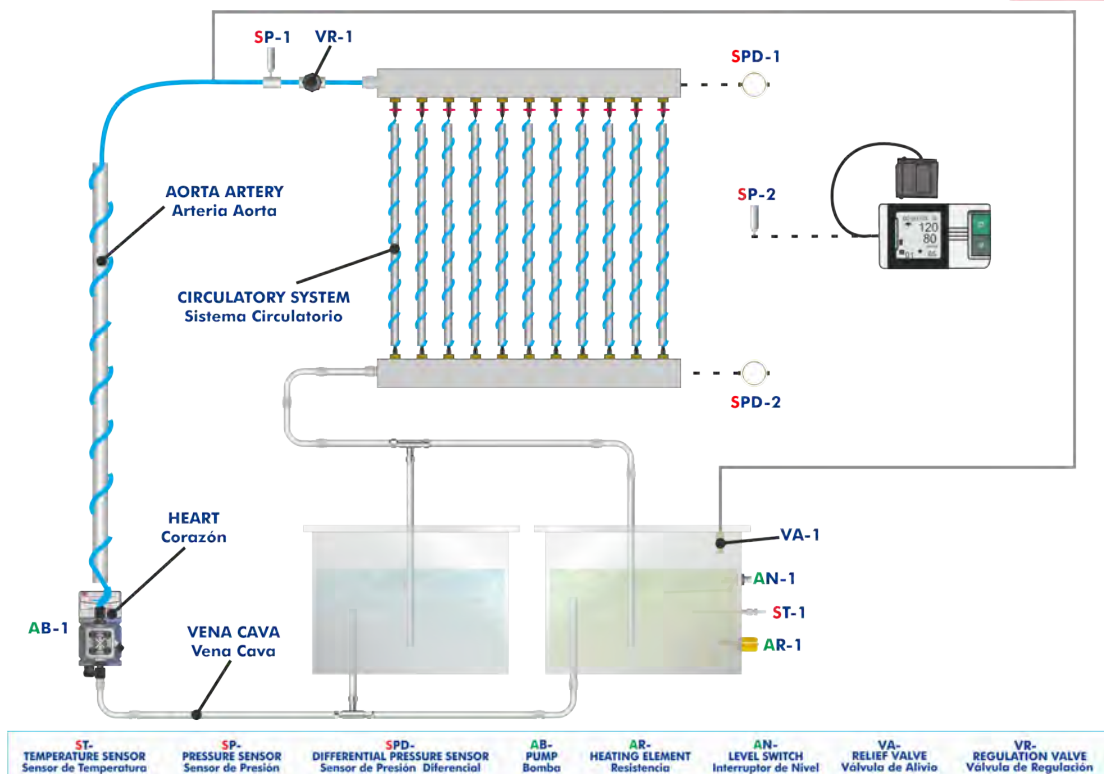
PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

3 actuators and 5 sensors controlled from any computer, and working simultaneously

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

SP-1 VR-1
SPD-1
SP-2

AORTA ARTERY
Arteria Aorta

CIRCULATORY SYSTEM
Sistema Circulatorio

SPD-2

HEART
Corazón

VA-1
AN-1
ST-1
AR-1

AB-1

VENA CAVA
Vena Cava

ST- TEMPERATURE SENSOR Sensor de Temperatura	SP- PRESSURE SENSOR Sensor de Presión	SPD- DIFFERENTIAL PRESSURE SENSOR Sensor de Presión Diferencial	AB- PUMP Bomba	AR- HEATING ELEMENT Resistencia	AN- LEVEL SWITCH Interruptor de Nivel	VA- RELIEF VALVE Válvula de Alivio	VR- REGULATION VALVE Válvula de Regulación

With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4, 5 and 6.

- Optional items: 7, 8 and 9.

Let us describe first the main items (1 to 6):

① **BICSC. 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.

Set of tubes to simulate blood vessels:

Flexible tube with a diameter of 8 mm (aorta).

Tube with a diameter of 6 mm (vena cava).

10 tubes with a diameter of 0.8 mm (arteries).

Three-ways valve to control the flow in the tubes.

Transparent tank of 16 l with separation to study water and another fluid of higher viscosity (simulating blood). It includes:

Heating element computer controlled (PID Control). Power: 0.5 kW.

"J" type temperature sensor.

Level switch.

Dosing pump, computer controlled. Maximum flow rate: 18 l/h.

Regulation valve.

Safety valve.

Pressure sensor (0 - 100 psi).

Two differential pressure sensor (0 - 15 psi).

Analog rotational viscometer (1 - 100000 mPa/s).

Digital blood pressure monitor.

Pressure sensor for blood pressure monitor (0 - 5 psi).

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: BICSC

② BICSC/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.

BICSC/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: <u>250 KS/s (kilo samples per second)</u>.

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 BICSC/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 <u>250 KS/s (kilo samples per second)</u>.**

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.
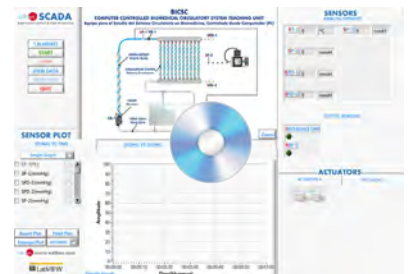
BICSC/CCSOF

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: BICSC + BICSC/CIB + DAB + BICSC/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.- Measurement of blood viscosity.

2.- Measurement of the flow velocity.

3.- Understanding aortic aneurysm.

4.- Understanding thrombosis.

5.- Comparison of water and blood flow characteristics.

6.- Determination of the Reynolds number of blood.

7.- Determination of the resistance of vessels to blood flow.

8.- Determination of the pressure drop.

9.- Relationship between temperature and velocity in blood flow.

10.- Relationship between temperature and viscosity in blood flow.

11.- Understanding the operation of a digital blood pressure monitor.

Additional practical possibilities:

12.- Sensors calibration.

Other possibilities to be done with this Unit:

13.- Many students view results simultaneously.

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

14.- 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.

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

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

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

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

19.- Control of the BICSC unit process through the control interface box without the computer.

20.- Visualization of all the sensors values used in the BICSC 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.
- Water supply and drainage.
- Computer.

## DIMENSIONS AND WEIGHTS

BICSC:
  Unit:
  - Dimensions: 710 x 750 x 710 mm approx.
              (27.95 x 29.52 x 27.95 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.)

RECOMMENDED ELEMENTS (Not included)

- Instrumentation: scales and beaker.

SCADA and PID Control
Main screen
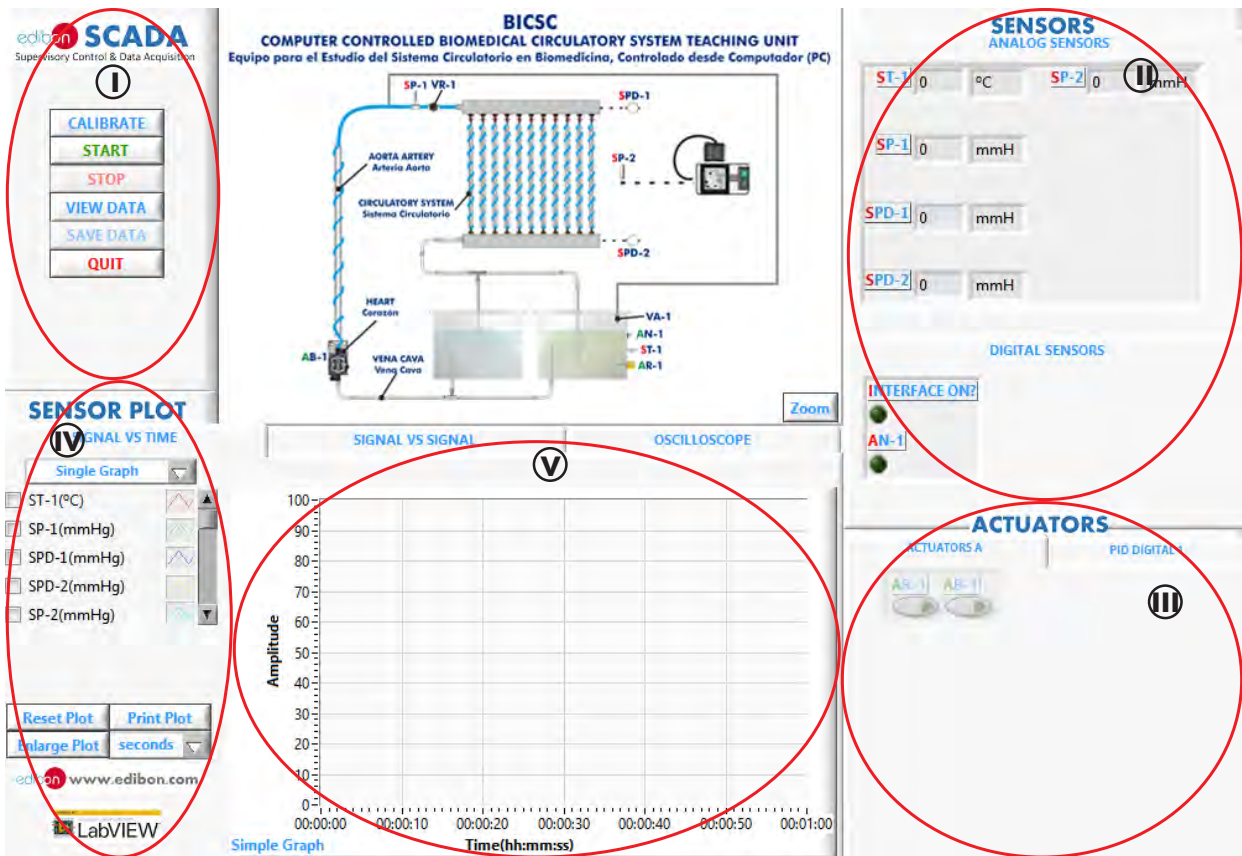
① Main software operation possibilities.

② Sensors displays, real time values, and extra output parameters. Sensors: ST=Temperature sensor. SP=Pressure sensor. SPD=Differential Pressure Sensor.

③ Actuators controls. Actuators: AR=Heating element. AB=Pump. AN=Leven Switch.

④ Channel selection and other plot parameters.
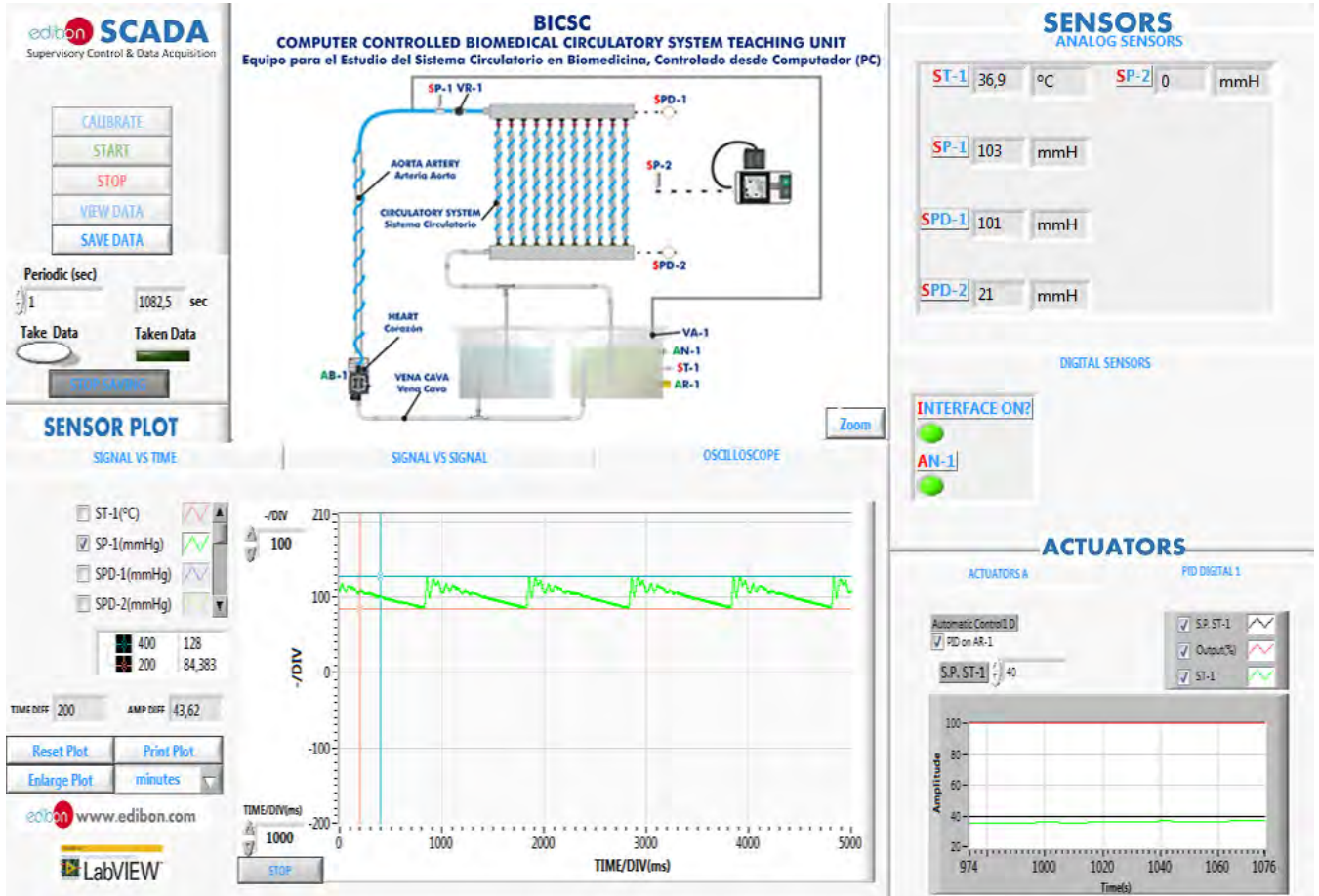
⑤ Real time graphics displays.

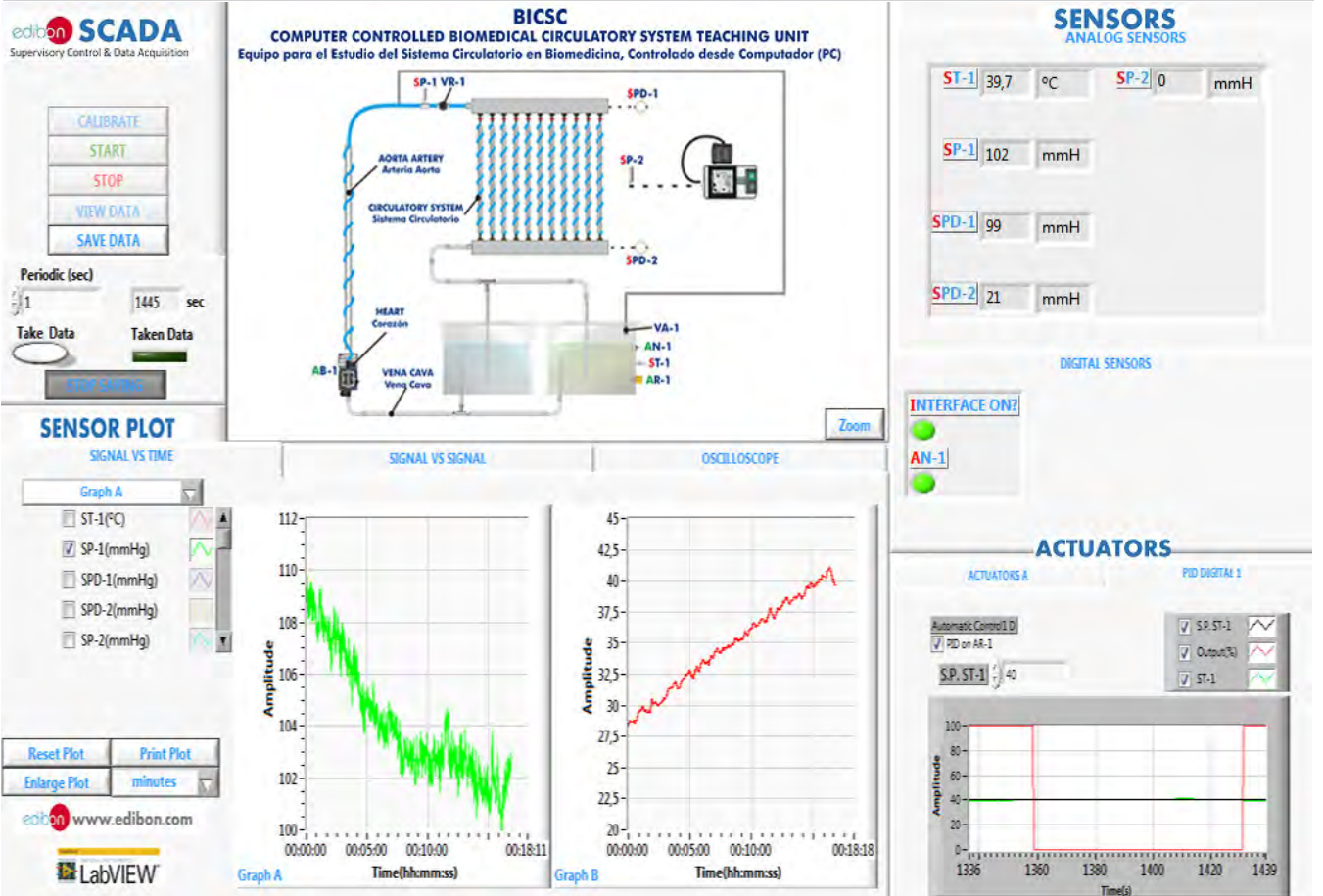## Software for Sensors Calibration
Example of screen
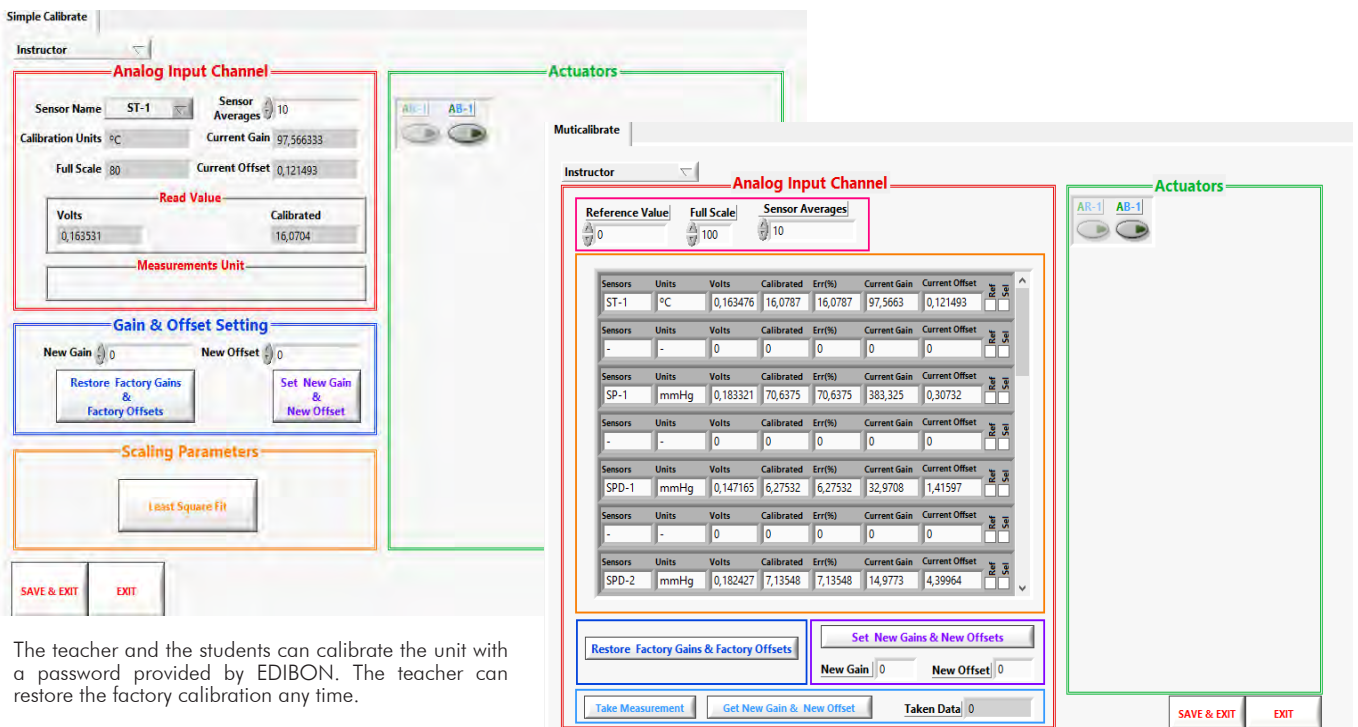
The teacher and the students can calibrate the unit with a password provided by EDIBON. The teacher can restore the factory calibration any time.

Representation in real time of the measured magnitudes. Blood pressure measurement.

Representation in real time of the measured magnitudes.

Heating temperature control is done through a PID control. When the target temperature is reached at the temperature sensor (ST-1), the heating element is turned off.

Representation in real time of the measured magnitudes.

Some **real** results obtained from this Unit

Representation in real time of the measured magnitudes.

edibon **SCADA**
Supervisory Control & Data Acquisition

BICSC
COMPUTER CONTROLLED BIOMEDICAL CIRCULATORY SYSTEM TEACHING UNIT
Equipo para el Estudio del Sistema Circulatorio en Biomedicina, Controlado desde Computador (PC)

CALIBRATE
START
STOP
VIEW DATA
SAVE DATA

Periodic (sec)
1   495   sec
Take Data   Taken Data

STOP SAVING

SP-1 VR-1
SPD-1
AORTA ARTERY
Arteria Aorta
SP-2
CIRCULATORY SYSTEM
Sistema Circulatorio
SPD-2
HEART
Corazón
VA-1
AN-1
ST-1
AR-1
AB-1
VENA CAVA
Vena Cava

Zoom

SENSORS
ANALOG SENSORS

ST-1 18,8 °C   SP-2 165 mmH
SP-1 0   mmH
SPD-1 0   mmH
SPD-2 0   mmH

DIGITAL SENSORS
INTERFACE ON?
AN-1

SENSOR PLOT
SIGNAL VS TIME   SIGNAL VS SIGNAL   OSCILLOSCOPE

SP-1(mmHg)
SPD-1(mmHg)
SPD-2(mmHg)
SP-2(mmHg)

-/DIV 100
400   100
200   0

TIME DIFF 200   AMP DIFF 100

Reset Plot   Print Plot
Enlarge Plot   seconds
edibon www.edibon.com
LabVIEW

TIME/DIV(ms) 200
STOP

ACTUATORS
ACTUATORS A   PID DIGITAL 1
AR-1   AB-1

-/DIV
250
200
100
0
0   200   400   600   800   1000
TIME/DIV(ms)

Visualization and representation of saved data.

OPEN FILE   CLOSE

FILE NAME
Saved data_"BICSC".xls

SIGNALS VS TIME   SIGNAL VS SIGNAL

ST-1(°C)   1
SP-1(mmHg)   1
SPD-1(mmHg)   1
SPD-2(mmHg)   1
SP-2(mmHg)   1
INTERFACE   1
AN-1   1
AR-1   1
AB-1   1
Automatic   1
Set Point1   1
PID output1   1

ST-1(°C)
SP-1(mm
SPD-1(mm
SPD-2(mm
SP-2(mm
INTERFAC
AN-1
AR-1
AB-1
Automati
Set Point1
PID outpu

180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
360 365 370 375 380 385 390 395 400 405 410 415 420
Time(s)
Amplitude

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 9.

All these items try to give more possibilities for:

a) Technical and Vocational Education configuration. (ICAI)

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

a) Technical and Vocational Education configuration

⑦ **BICSC/ICAI. Interactive Computer Aided Instruction Software System.**
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).

- 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.

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

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

Instructor Software
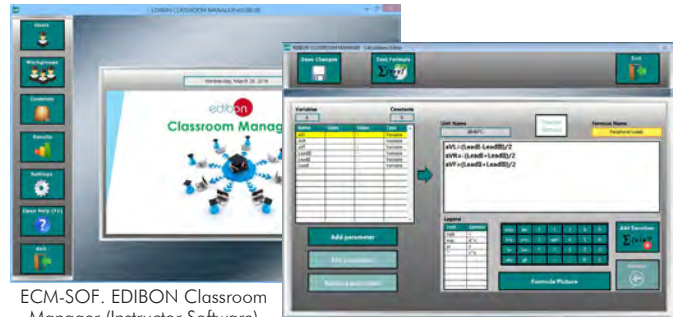
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen
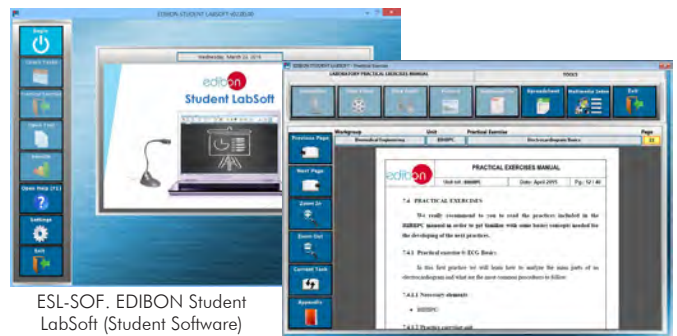
ECAL. EDIBON Calculations Program Package - Formula Editor Screen

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram
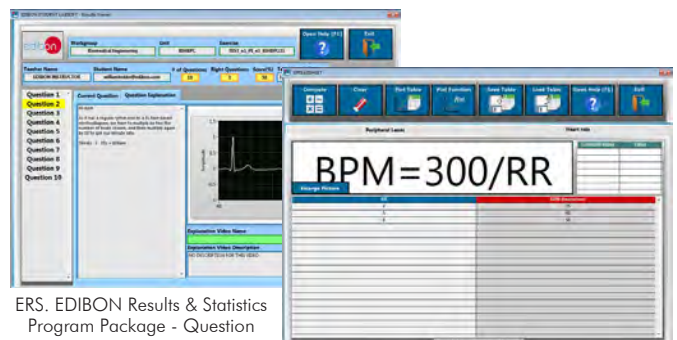
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software

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

EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

b) Multipost Expansions options

⑧ **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 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, 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.

⑨ 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 Biomedical Circulatory System Teaching Unit (BICSC)

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

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
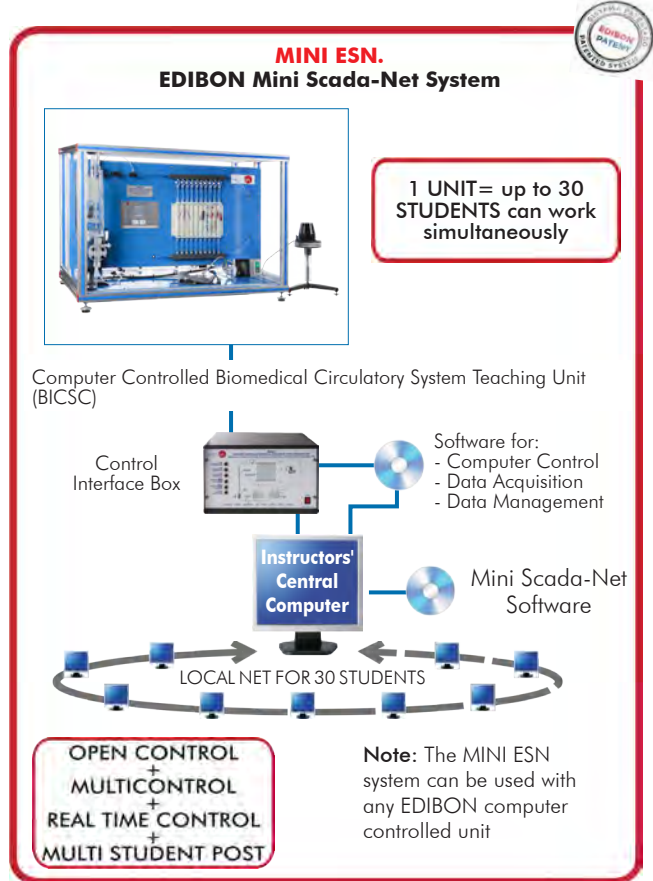
ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: BICSC. Computer Controlled Biomedical Circulatory System Teaching Unit.**

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

③ **DAB. Data Acquisition Board.**

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

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

⑥ **Manuals.**

*IMPORTANT: Under BICSC 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 BICSC/ICAI. Interactive Computer Aided Instruction Software System.

b) Multipost Expansions options

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Safety valve.
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Two differential pressure sensor (0 - 15 psi).
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Pressure sensor for blood pressure monitor (0 - 5 psi).
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    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.

②BICSC/CIB. Control Interface Box:
The Control Interface Box is part of the SCADA system.
Control interface box with process diagram in the front panel.
The unit control elements are permanently computer controlled.
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.
All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
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 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.
Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

③DAB. 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.
Analog input: Channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).
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.

④BICSC/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.

⑤Cables and Accessories, for normal operation.

⑥Manuals:
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.- Measurement of blood viscosity.

2.- Measurement of the flow velocity.

3.- Understanding aortic aneurysm.

4.- Understanding thrombosis.

5.- Comparison of water and blood flow characteristics.

6.- Determination of the Reynolds number of blood.

7.- Determination of the resistance of vessels to blood flow.

8.- Determination of the pressure drop.

9.- Relationship between temperature and velocity in blood flow.

10.- Relationship between temperature and viscosity in blood flow.

11.- Understanding the operation of a digital blood pressure monitor.

Additional practical possibilities:

12.- Sensors calibration.

Other possibilities to be done with this Unit:

13.- Many students view results simultaneously.

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

14.- 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.

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

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

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

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

19.- Control of the BICSC unit process through the control interface box without the computer.

20.- Visualization of all the sensors values used in the BICSC unit process.

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

a) Technical and Vocational Education configuration

⑦ **BICSC/ICAI. Interactive Computer Aided Instruction Software System.**

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.

b) Multipost Expansions options

⑧ **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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