Innovative engineering, technical teaching and research equipment

Technical Education Project Presentation (TEPP)
Content

1. Technical Education problems and solutions.

2. Teaching technology evolution.

3. Teaching technology possibilities today designed and offered by EDIBON.

4. Some recommendations for designing a Technical Education Project

5. How to develop a Technical Education Project for a country needs.

6. All financing options.

7. Other EDIBON Business Models.

8. “Value for money” Approaches.
1. Technical education problems and solutions.

Multilateral procurement regulations includes more and more the principle of: quality, technology and value for money in contract design. Edibon provides these three features and consider that the solution, for the proper technical education demanded by the industry today in any country in the world, require SCADA teaching units and the SCADA expansions (SCADA+PLC, ESN, ECL, etc).

**Main constrains detected by Edibon on today’s higher, technical and vocational education**

<table>
<thead>
<tr>
<th>Larger GAP:</th>
<th>Between passing out students and the Industries.</th>
</tr>
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<tbody>
<tr>
<td>Trained PROFESSIONALS</td>
<td>Reduce number of qualified training staff using MODERN techniques.</td>
</tr>
<tr>
<td>Technology SHORTAGE:</td>
<td>In terms of availability of latest technology for equipment.</td>
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<td>VALUE FOR MONEY:</td>
<td>Lack of efficiency in theory-practical teaching and number of student per teacher.</td>
</tr>
<tr>
<td>Training STANDARDS:</td>
<td>Low training standards on professional teachers.</td>
</tr>
<tr>
<td>SEPARATE labs and classroom:</td>
<td>Not allow one teacher to teach theory and practices simultaneously.</td>
</tr>
<tr>
<td>LONG TERMS focus:</td>
<td>Not considered in both training sustainability.</td>
</tr>
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</table>
1. Technical education problems and solutions.

Solutions provided by EDIBON to these MAJOR CONSTRAINTS in terms of Quality, Value-for-Money & Cost Reduction

<table>
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<tr>
<th><strong>Solutions provided within TECHNICAL SPECIFICATIONS:</strong></th>
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<tr>
<td><strong>TEACHING units:</strong> Provided Technical Teaching units in all technical areas.</td>
</tr>
<tr>
<td><strong>SCADA system:</strong> Has become a reference in the international market as the most appropriate solution.</td>
</tr>
<tr>
<td><strong>TOR definition:</strong> EDIBON has become an expert in providing consultancy services on TOR (Terms of Reference) definitions according to solutions required and availability in the market</td>
</tr>
<tr>
<td><strong>ONE Teacher:</strong> Able to teach technical theory and practice in a classroom-Laboratory and controlling level of understanding of students in real time.</td>
</tr>
<tr>
<td><strong>30 Students:</strong> Working simultaneously with one or several units under the supervision of a single teacher.</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Solutions provided in terms of SCALABILITY:</strong></th>
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<tr>
<td><strong>Equipment ADAPTABILITY:</strong> Independent equipment units can be integrated to complete laboratory system. Teaching Equipment similar to the industry’s, including the control system. Essential for students understanding.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Increased OUTPUTS with additional key services:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>* Project and Complete Laboratories supplied by EDIBON, advanced and modern own technology.</td>
</tr>
<tr>
<td>* Turn Key Projects (TKP) with our soft financing options</td>
</tr>
<tr>
<td>* Technical Distance Learning (ECL)</td>
</tr>
<tr>
<td>* Custom Made Units and Pilot Plants. Courses with advanced Teaching Unit + University Teachers + EDIBON Engineers, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Collaterals:</strong></th>
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<tbody>
<tr>
<td>Laboratory adaptation. Units installation and commissioning. Training by EDIBON’s engineers. After sales service, including remote control. Sustainability. Warranties... and much more.</td>
</tr>
</tbody>
</table>
2. Teaching equipment technology evolution.

1. Traditional Manual Units / Software Simulation

Not recommended nowadays as modern teaching technologies are available.

OLD OPTION. NOT RECOMMENDED

2. Units With Data Acquisition

Few companies in the world offer Data Acquisition as additional value to manual units.

SAVES TIME BUT IT IS NOT A PROPER SOLUTION

3. EDIBON Units + SCADA System

EDIBON is a pioneer company that offers SCADA for thousands of Teaching Units since 30 years ago.

SCADA IS THE SOLUTION

4. EDIBON Industrial Units (SCADA+PLC’s)

This is the only Real Industrial Teaching Systems.

5. Multipost EDIBON SCADA-NET (ESN)

This system allows up to 30 students to use different units in the laboratory working simultaneously under the supervision of a single teacher

6. Multipost EDIBON Cloud Learning (ECL)

EDIBON Teaching Unit with SCADA in one location and students/teachers in a different location
3. Teaching technology possibilities today designed and offered by EDIBON.

3.1 Main Teaching Techniques available today:
   3.1.1 Development of modern Teaching Techniques, as a consequence of advance technology used and designed, by EDIBON.
   3.1.2 Multipost Teaching Techniques.
   3.1.3 Technical Distance Learning (ECL).

3.2 SCADA description and sectors of its application.
   3.2.1 SCADA meaning.
   3.2.2 SCADA configuration.
   3.2.3 SCADA advantages and typical results.
   3.2.4 SCADA research possibilities.

3.3 SCADA + PLC Control. (Real Industrial System).

3.4 ICAI (Interactive Computer Aided Instruction Software).

3.5 FSS (Fault Simulation Software).

3.6 Multipost.
   3.6.1 Mini ESN. Mini EDIBON SCADA – NET.
   3.6.2 ESN. EDIBON SCADA – NET.
   3.6.3 ESN references.

3.7 Technical Distance Learning. (ECL – EDIBON Cloud Learning).
   3.7.1 Alignment with the new and future Procurement regulation of Multilateral and Bilateral financing banks.
   3.7.2 ECL – EDIBON Cloud Learning.
3. Teaching technology possibilities today.
3.1 Main Teaching Techniques available today.

3.1.1 Development of modern Teaching Techniques, as a consequence of advanced technology used, by EDIBON

EDIBON PATENT

SCADA: Supervisory Control And Data Acquisition

PLC: Programmable Logic Controller Software custom made for any unit.

REAL INDUSTRIAL TEACHING SYSTEM

ADDITIONAL TEACHING TECHNICS USED WITH INDIVIDUAL UNITS
3. Teaching technology possibilities today.
3.1 Main Teaching Techniques available today.
3.1.2 Multipost Teaching Techniques.

Mini ESN
3. Teaching technology possibilities today.
3.1 Main Teaching Techniques available today.

3.1.3 Technical Distance Learning (ECL).
3. Teaching technology possibilities today.
3.2 SCADA description and sectors of its application.

3.2.1 SCADA meaning.

SUPERVISION
CONTROL
And
DATA
ACQUISITION
3. Teaching technology possibilities today.
3.2 SCADA description and sectors of its application.

3.2.2 SCADA configuration.
3. Teaching technology possibilities today.
3.2 SCADA description and sectors of its application.

3.2.3 SCADA advantages and typical results.

**Key Innovative Features:**
- Advanced Real-Time SCADA and PID Control.
- Open Control + Multicontrol + Real-Time Control.
- Specialized EDIBON Control Software based on LabView.
- Calibration exercises.
- Projector and/or electronic whiteboard compatibility.
- Capable of doing applied research.
- Remote operation and control.
- Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).
- Designed and manufactured under several quality standards.

**Teaching advantages:**
- The student identifies and can see and compare, at the same time, the unitary process with Mathematic formula.
- Quick and clear understanding.
- Unitary process analysis in details.
- Apply research with zero additional cost.
- Approximately **DOUBLE TRAINING possibilities** compared with manual unit.

**Cost:**
- **EDIBON SCADA** with PID Control. **SIMILAR PRICE** than any other European manufacturers that DO NOT use SCADA.
All Teaching Units using EDIBON SCADA, can be used with no additional cost, for doing APPLIED RESEARCH.

All Teaching Units using EDIBON SCADA, with small additional cost, using EDIBON LabView Kit (ELK) can be used for doing ADVANCE RESEARCH.
3. Teaching technology possibilities today.

3.3 SCADA + PLC Control. (Real Industrial System).

PLC – Programmable Logical Controller. Real Industrial System

**PLC Additional practices to the SCADA ones:**

- 1. - Control of the unit process through the control interface box without the computer.
- 2. - Visualization of all the sensors values used in the unit process.
- 3. - Calibration of all sensors included in the unit process.
- 4. - Hand on of all the actuators involved in the unit process.
- 5. - Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 6. - Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc.).
- 7. - PLC hardware general use and manipulation.
- 8. - PLC process application for the unit.
- 9. - PLC structure.
- 10. - PLC inputs and outputs configuration.
- 11. - PLC configuration possibilities.
- 12. - PLC program languages.
- 13. - PLC different programming standard languages.
- 14. - New configuration and development of new process.
- 15. - Hand on an established process.
- 16. - To visualize and see the results and to make comparisons with the unit process.
- 17. - Possibility of creating new process in relation with the unit.
- 18. - PLC Programming exercises.
- 19. - Own PLC applications in accordance with teacher and student requirements.

**Teaching advantages:**

- The student can work at SCADA mode and/or PLC mode.
- Many processes in Industry use SCADA + PLC.
- Quick and clear use of SCADA + PLC.
ICAI incorporates E-Learning into the curriculum in response to one of the instructor's main tasks, providing the students the right tools to learn by themselves in the most efficient and painless way.

The ICAI, Interactive Computer Aided Instructor Software System, helps both the teacher and the students.

It helps the teachers by:

a. Scheduling their classes and tasks easily.
b. Checking in real time what any student is doing and enabling the instructors to teach faster and more efficiently.
c. Supervising the students understanding progress and level, questions and answers as well as the whole class evolution.
d. Ensuring more individual attention.
e. Adapting the learning patterns.
f. Reducing the preparation time for lessons.
g. Teaching easily.

It helps the students by:

a. Enabling them to understand the operation of any EDIBON Teaching Unit and the principles involved easily. This software can be used for all manual computer controlled EDIBON SCADA units.
b. Providing them modern tools so that they are able to get clear ideas and quick understanding.
c. Saving time.
3. Teaching technology possibilities today.

3.5 FSS (Fault Simulation Software).

Faults Simulation System (FSS) enables to safely reproduce signs of faults in the processes carried out by EDIBON teaching equipment.

These faults are simulated, since the detected anomalies, indicating such faults, have been previously programmed and they only take place fictitiously. Therefore, real equipment is not damaged at any time.

The teaching objectives of this teaching technique are as follows:
1. The identification of anomalies or signs of the faults detected in software.
2. The diagnosis of potential faults that may be causing the aforementioned anomalies.
3. The development of the appropriate corrective actions for the potential faults that have been diagnosed.

Therefore, this tool has a high teaching potential to train highly qualified professionals, with the ability to monitor and to keep real industrial processes operating as efficiently as possible.
3. Teaching technology possibilities today.
3.6 Multipost.

3.6.1 Mini ESN. Mini EDIBON SCADA – NET.

EDIBON Mini ESN = “1 SCADA EDIBON Unit”, allowing 30 students to work simultaneously with only one teacher “teaching theory and practices” at the same time.

**Mini ESN (EDIBON Mini Scada-Net System)** allows up to 30 students to work with an EDIBON Computer Controlled Unit in any laboratory, simultaneously.

The Mini ESN system consists on the adaptation of one of the EDIBON Computer Controlled Units 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).

The Mini ESN allows the teacher to know in “real time” the level of any student understanding.
3. Teaching technology possibilities today.
3.6 Multipost.

3.6.2 ESN. EDIBON SCADA – NET.

**ESN main advantages:**
- 30 students can work simultaneously.
- Only one teacher controls and explains to ALL students at the same time.
- All units at the laboratory can be interconnected.
- Lower cost per student.
- The efficiency **increases** drastically.

**Local Net:**
- The ESN System allows all units and students’ computers, and teacher’s computers, to be interconnected.

**Note:**
- All EDIBON’s Computer Controlled Units that use “SCADA” can be **integrated in any SCADA-NET** (ESN) System.

**ESN costs analysis:**
- Unit cost = 1x
- System cost = 1x
- Total cost = 2x

- 30 Students
- 2 x Total cost = 15

**ESN Additional Advantages:**
- Laboratory and classroom AT THE SAME PLACE.
- 30 students working SIMULTANEOUSLY.
- Only one teacher teaching theory and practices AT THE SAME TIME.
- Higher Teaching Efficiency.
3. Teaching technology possibilities today.

3.6 Multipost.

3.6.3 ESN references.

Example: Scada–Net System (ESN)
Laboratory: Renewable Energie

Available SCADA-NET Systems with EDIBON units in the areas of:

- Physics.
- Electronics and Communications.
- Electricity.
- Energy.
- Renewable Energies.
- Fluid Mechanics.
- Thermodynamics.
- Process Control.
- Chemical Engineering.
- Food Technology.
- Environment.
- Biomedical.

ESN. References.

<table>
<thead>
<tr>
<th>Country</th>
<th>Systems working</th>
<th>Systems ordered</th>
<th>Systems quoted</th>
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<tbody>
<tr>
<td>Pakistan</td>
<td>4</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>24</td>
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</tr>
<tr>
<td>Peru</td>
<td>2</td>
<td>-</td>
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</tr>
<tr>
<td>USA</td>
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<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1</td>
<td>-</td>
<td>29</td>
</tr>
<tr>
<td>Oman</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other 25</td>
<td>-</td>
<td>-</td>
<td>500</td>
</tr>
<tr>
<td>countries</td>
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<td></td>
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<tr>
<td>Total</td>
<td><strong>10</strong></td>
<td><strong>32</strong></td>
<td><strong>669</strong></td>
</tr>
</tbody>
</table>

15 TIMES LOWER COST PER STUDENT
3. Teaching technology possibilities today.

3.7 Technical Distance Learning. (ECL – EDIBON Cloud Learning).

3.7.1 Alignment with the new and future Procurement regulation of Multilateral and Bilateral financing banks.

**ECL Analysis:**
- Master unit: EDIBON unit with SCADA in one place and/or city.
- Satellite unit: Up to 100 other centers in other places or cities students can use the pilot unit.
- Unit control IN REAL TIME.
- Visualization camera included.

**Use option:**
- Satellite places can use the master unit from:
  - Other laboratories.
  - Students homes.
  - Students mobile phones.

**ECL Costs:**
- Unit cost = 1x
- System cost = 1x
- Total cost = 2x

\[
\text{Total cost} = 2 \times 100 = 200 \text{ places}
\]

**Advantages:**
- Lower maintenance costs.
- Teaching theory and practices at the same time.
- Many satellite centers can be connected with the unit in the Pilot Center.

**ECL Customer references:**
- System designed 8 years ago.
- Commercialization since July 2017.
- One order for Villalkor College (Madrid – Spain).
- Enquiries from Tamil Nadu (Chennai – India), Honduras, Kazakhstan, Nigeria, and on.
3. Teaching technology possibilities today.

3.7 Technical Distance Learning. (ECL – EDIBON Cloud Learning).

3.7.2 ECL – EDIBON Cloud Learning.

Example:

Secondary Education

End Customer: Tamil Nadu Government (India)

EDIBON Cloud Learning (ECL) for Secondary Education

Complete System

M: 42 Master Schools.
S: 100 Satellite Schools for any Master School.
4,200 Satellite Schools.

Comparative COSTS

- One school estimated to be equipped = 50,000€
- Cost using ECL = 210M€

The ECL COST IS 50 TO 100 TIMES LOWER

Example:

Higher, Technical and Vocational Educations

End Customer: Government of Kyrgyzstan

EDIBON Cloud Learning (ECL) for Higher, Technical and Vocational Educations based on ESN System

Complete System

M: 3 Complete Master Laboratories.
S: “N” Satellite Training Centers in the country. Any student can use the system from home.

Comparative COSTS

- Complete Master Laboratory = 50M€
- 3 Complete Master Laboratory = 150M€
- ECL System for all units = 150M€

The ECL + ESN cost AT LEAST 60 TO 100 TIMES LOWER depending the number of satellite schools.
4. Some recommendations for designing a Technical Education Project?

There are two evidences to be considered when someone has to decide what are the best solutions for having a good Teaching Education in a country. There are not big differences, related with the curricula used in any country related with most of the disciplines. The point is that the responsible authorities, in any country, have to chose the proper disciplines related with the present and future production in the country.

There is another evidence to be considered. The proper tools at the laboratory. If you consider, two young men, one in an industrialized country and another in a poor country, we cannot say one is smarter than the other one. If we do the same analysis with teachers, we cannot say that a teacher in a rich country is smarter than the one in a poor country, but the “evidence” is that the Engineers or Technicians in rich countries, are better prepared than the ones in poor countries, so where are the differences?

The difference are the “TOOLS” they use for learning!

There are many parameters involved in the tools, but the main tools that maybe has 80% influence for having the proper solution are “Teaching Technology used at the laboratories”.

“Advanced Teaching Technology in the laboratories, is the solution”.

If two engineers studying in a poor or rich country, if we maintain all teacher parameters similar, the better engineer is the one that use the most advanced teaching technology, in a rich or poor country.

As we graphically demonstrate in a previous paragraph, the SCADA and SCADA + PLC are excellent tools for having proper graduates, using same technology as the one used in any industry in the world.

There are other Teaching Systems, that improve the quality and reduce the cost per student drastically, as SCADA-NET and Cloud Learning. Other Teaching Systems, as Interactive Computer Aided Instruction and Fault Simulation, improves the quality.

How to develop the proper Technical Education Project? By using modern Teaching Techniques and Advanced Technical Teaching Unit. In next paragraph, we describe the solution…
5. How to develop a Technical Education Project for a country needs?

5.1 Example of Project Presentation.

5. How to develop a Technical Education Project for a country needs?

5.1 Example of Project Presentation.
5. How to develop a Technical Education Project for a country needs?
5.1 Example of Project Presentation.

* Center:

* Country:

* Date:

* Issue:

Quality Certificates:
Higher Technical Education Training Center

Destination:

Index

- Project content and blocks.
- Technical areas included using advanced technology.
- Modules list available for laboratories and workshops.
- Example of Classroom and Laboratory Lay Out (3D).
- Main project targets.
- Project options covered.
- Project conditions.
- Teaching techniques used.
Project content and blocks

Modern design

Main blocks

Products

Full units design
Technical areas included using advanced technology

* Physics and Chemistry.
* Electronics.
* Communications.
* Electricity.
* Energy.
* Systems and Automatics.
* Fluids Mechanics and Aerodynamics.
* Thermodynamics and Thermotechnics.
* Process Control.
* Chemical Engineering.
* Food and Water Engineering.
* Environment.
* Biomedical Engineering.
* Additional instruments and tools.

Note: The complete technical design will be ready soon.
### MODULES LIST AVAILABLE FOR LABORATORIES AND WORKSHOPS

**0100 . PHYSICS**

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<td>Basic Module</td>
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<td>0111</td>
<td>3D PHYSICS (MINI-ESN), Medium Module</td>
<td>Medium Module</td>
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<td>CHEMISTRY MODULE, Basic Module</td>
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**0200 . ELECTRONICS**

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**0300 . COMMUNICATIONS**

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**0400 . ELECTRICITY**

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<td>0432</td>
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**0500 . ENERGY**

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<tr>
<th>Code</th>
<th>Module Description</th>
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<td>0510</td>
<td>MODULAR SMART GRID AND POWER SYSTEMS SIMULATOR, Basic Module</td>
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0511. MODULAR SMART GRID AND POWER SYSTEMS SIMULATOR. Medium Module
0512. MODULAR SMART GRID AND POWER SYSTEMS SIMULATOR. Advanced Module
0530. RENEWABLE ENERGIES. Basic Module
0531. RENEWABLE ENERGIES. Medium Module
0532. RENEWABLE ENERGIES. Advanced Module
0595/ESN. EDIBON SCADA -NET FOR BEING USED WITH ENERGY UNITS
0596/ECL. EDIBON CLOUD LEARNING FOR "ENERGY"

0600. MECHATRONICS, AUTOMATION & COMPUMECHATRONICS
0610. PLC TRAINER (Panasonic or any other brand).
0611. PLC TRAINER AND PLC PROCESS EMULATORS. Basic Module
0612. PLC TRAINER AND PLC PROCESS EMULATORS. Medium Module
0613. PLC TRAINER AND PLC PROCESS EMULATORS. Advanced Module
0620. PLC TRAINER AND PLC SMALL REAL APPLICATIONS.
0630. INDUSTRIAL PLC APPLICATIONS
0650. AUTOMATION AND SYSTEMS. Basic Module
0651. AUTOMATION AND SYSTEMS. (REGULATION AND CONTROL). Medium Module
0652. AUTOMATION AND SYSTEMS. (CONTROL). Advanced Module
0696/ECL. EDIBON CLOUD LEARNING FOR "MECHATRONICS, AUTOMATION & MECHATRONICS"

0700. MECHANICS
0710. MECHANICS. Basic Module
0711. MECHANICS. Medium Module
0712. MECHANICS. Advanced Module
0720. AUTOMOTIVE. Basic Module
0721. AUTOMOTIVE. Medium Module
0730. FOUNDRY. Basic Module
0731. FOUNDRY. Medium Module
0740. STRENGTH OF MATERIALS. Basic Module
0741. STRENGTH OF MATERIALS. Medium Module
0742. STRENGTH OF MATERIALS. Advanced Module
0750. PHOTOELASTICITY. Basic Module
0751. PHOTOELASTICITY. Medium Module
0752. PHOTOELASTICITY. Advanced Module
0780. BUILDING (ARCHITECTURE). Basic Module
0781. BUILDING (ARCHITECTURE). Medium Module
0795/ESN. EDIBON SCADA -NET FOR BEING USED WITH MECHANICS AND MATERIALS UNITS
0796/ECL. EDIBON CLOUD LEARNING FOR "MECHANICS"

0800. FLUID MECHANICS
0810. FLUID MECHANICS (ELEMENTARY). Basic Module
0811. FLUIDS MECHANICS (ELEMENTARY). Medium Module
0812. FLUIDS MECHANICS (ELEMENTARY). Advanced Module
0820. FLUID MECHANICS (GENERAL). Basic Module
0821. FLUID MECHANICS. (CHANNEL 80mmSECTION). Basic Module
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0830. HYDRAULIC MACHINES (PUMPS). Basic Module
0831. HYDRAULIC MACHINES (PUMPS). Medium Module
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0833. HYDRAULIC MACHINES (FAN - CENTRIFUGAL). Basic Module
0834. HYDRAULIC MACHINES (FAN-AXIAL). Medium Module
0835. HYDRAULIC MACHINES (COMPRESSOR - CENTRIFUGAL). Basic Module
0836. HYDRAULIC MACHINES (TWO-STAGE COMPRESSOR). Medium Module
0840. HYDRAULIC MACHINES (TURBINES-WATER). Basic Module
0841. HYDRAULIC MACHINES (TURBINES-WATER). Medium Module
0842. HYDRAULIC MACHINES (TURBINES-AIR). Advanced Module
0850. AERODYNAMICS. Basic Module
0851. AERODYNAMICS. Advanced Module
0895/ESN. EDIBON SCADA-NET FOR BEING USED WITH THE FLUIDS MECHANICS UNITS
0896/ECL. EDIBON CLOUD LEARNING FOR "FLUID MECHANICS"

0900. THERMODYNAMICS & THERMOTECHNICS
0910. REFRIGERATION. Basic Module
0911. REFRIGERATION. Medium Module
FOOD TECHNOLOGY (MILK). Advanced Module
FOOD TECHNOLOGY (OIL). Basic Module
EDIBON SCADA -NET FOR BEING USED WITH FOOD AND WATER TECHNOLOGIES UNITS
EDIBON CLOUD LEARNING FOR “FOOD & WATER TECHNOLOGIES”

1300 . ENVIRONMENT

WATER HANDLING. Basic Module
WATER HANDLING. Medium Module
WATER HANDLING. Advanced Module
WATER TREATMENT (DIRTY). Basic Module
WATER TREATMENT (DIRTY). Medium Module
WATER TREATMENT (CLEAN). Basic Module
WATER TREATMENT (CLEAN). Medium Module
POLLUTION (GROUND). Basic Module
POLLUTION (GROUND). Medium Module
POLLUTION (AIR). Medium Module
ENVIRONMENTAL ENGINEERING PROCCESS). Basic Module
EDIBON SCADA -NET FOR BEING USED WITH ENVIRONMENT UNITS
EDIBON CLOUD LEARNING FOR “ENVIRONMENT”

1400 . BIOMEDICAL ENGINEERING

BIOMEDICAL APPLICATION MODULE
COMPUTER CONTROLLED STEAM STERILIZER WITH SCADA.
EDIBON SCADA -NET FOR BEING USED WITH BIOMEDICAL ENGINEERING UNITS Engineering Units
EDIBON CLOUD LEARNING FOR “BIOMEDICAL ENGINEERING”
Example of Classroom and Laboratory Lay Out
Main project targets

* To help the students:

  - By "quick" understanding.
  - By "clear" understanding (clear concepts).
  - By "saving" time.
  - By "extending" the laboratory to their homes.

* To help the teachers:

  - By "easy" teaching.
  - By increasing the teaching "efficiency".
  - By "reducing" teaching costs (less time consume).
  - By "integrating" classroom and laboratory in the same place.
Project options covered

This “Higher Technical Education Training Center” will cover the following:

a) To train students at laboratory.
b) To train trainers.
c) To be used for training and update educators in current teaching technologies.
d) To give courses to workers in the industry, as it simulates industrial process.
e) To be used for carrying out applied research, in several processes and different technical areas.
f) To be used as research tool for international projects.
g) To train other countries teachers.
Project conditions

The “Higher Technical Education Training Center” includes the following technical and commercial conditions:

a) Technical conditions:
   - Laboratories adaptation.
   - Installation of all units supplied.
   - Starting up for all units.
   - Training about the exercises to be done with teaching equipment.
   - Teacher training related with the teaching equipment and the teaching techniques used.
   - Technology transfer.

b) Commercial conditions:
   - Packing.
   - Financing Charges.
   - C.I.F. Charges.

c) Other conditions:
   - 8 Manuals for each teaching equipment:
     . Required services manual.
     . Assembly and installation manual.
     . Interface and software/control console manual.
     . Set in operation manual.
Teaching Techniques Used

3D Edibon Three Dimensions System

Software included:
- Control
- Data Acquisition
- Data Management

Interactive Computer Aided Software (ICAI)

All EDIBON areas

Edibon Data Acquisition System (EDAS)

Electronics (basic)
Communications
Electricity
Fluid Mechanics

Edibon System for High Electronics (RTC)

Electronics
High Tech Electronics (Control Electronics, Digital Electronics and Industrial Electronics)
Higher Technical Education
Training Center

Edibon Teaching Hybrid System (Energy)

Photoelasticity

Edibon SCADA

Edibon SCADA-NET System

www.edibon.com
Higher Technical Education Training Center

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28918 LEGANÉS, (Madrid), ESPAÑA.
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más información: www.edibon.com
5. How to develop a Technical Education Project for a country needs?

## RENEWABLE ENERGIES. Basic Module

<table>
<thead>
<tr>
<th>ITEM</th>
<th>REFERENCE</th>
<th>DESCRIPTION</th>
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<td>EESTC</td>
<td>COMPUTER CONTROLLED THERMAL SOLAR ENERGY UNIT</td>
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<td>EESFC</td>
<td>COMPUTER CONTROLLED PHOTOVOLTAIC SOLAR ENERGY UNIT</td>
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<td>EESFC/CAL</td>
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<td>EEEC</td>
<td>COMPUTER CONTROLLED WIND ENERGY UNIT</td>
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<td>6</td>
<td>EEEC/CAL</td>
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<td>EE-KIT</td>
<td>KIT OF CONVERSION AND CONSUMPTION SIMULATION (AC)</td>
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<td>8</td>
<td>EE-KIT2</td>
<td>GRID CONNECTION INVERTER KIT</td>
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</table>

### OTHER ITEMS INCLUDED:

- **PARTS**: COMPONENTS AND SPARE PARTS 1
- **PA**: COMPLEMENTARY ITEM 1
- **IYPM**: INSTALLATION AND STARTING-UP 1
- **CAPRO**: TRAINING AND BRINGING UP TO DATE OF TEA 1
- **TD**: TEACHING TECHNIQUE "KNOW-HOW" 1
- **MANU**: DOCUMENTATION AND MANUALS 1

### Notes:

1) Multipost option:
   - This module has only one unit for each item, but we can recommend the number of units for 10 or 30 students working simultaneously.

2) Supply conditions:
   a) Technical conditions included:
      - Laboratories adaptation.
      - Installation of all units supplied.
      - Starting up for all units.
      - Training about the exercises to be done with any unit.
      - Teacher training related with the teaching unit and the teaching techniques uses.
      - Technology transfer.
   b) Commercial conditions:
      - Packing.
      - Financing charges.
      - C.I.F. charges.
   c) Others conditions:
      - 8 Manuals for each EDIBON teaching unit:
        . Required services manual.
        . Assembly and installation manual.
        . Interface and software/control console manual.
        . Set in operation manual.
EESFC. Computer Controlled Photovoltaic Solar Energy Unit

**SPECIFICATIONS SUMMARY**

**Items supplied as standard**

1. **EESFC. Unit:**
   - “EESFC” is a computer controlled unit for the study of the transformation of solar energy in electric energy. This unit uses the photovoltaic solar system for the direct conversion of solar radiation into electricity. The absorbed energy is provided by simulated solar radiation; in our case, this is done by means of a panel with powerful light sources.
   - Anodized aluminium structure and panels in painted steel. Diagram in the front panel with similar distribution to the elements in the real unit.
   - 2 Photovoltaic solar panels (polycrystallines).
   - Solar simulator: Aluminium structure adjustable in horizontal position. 11 Solar spectrum lamps, distributed in two independent voltage regulated circuits. Electrical safety.
   - Ventilation system that allows us to analyze the temperature influence on the system performance operation.
   - DC Load and Battery Charger Regulator.
   - Auxiliary battery charger.
   - Battery.
   - DC Loads Module: DC lamps of 12Vdc. DC motor of 24-36Vdc. Rheostat of 300W.
   - Independent connection for every load with the help of the 4 Positions selector.
   - Sensors: 3 Temperature sensors (one in the solar panel 1, others in the solar panel 2 and another of room temperature). Light radiation sensor. DC current sensor and DC voltage sensor.

2. **Optional (NOT included in the standard supply):**
   - EE-KIT. Kit of Conversion and Consumption Simulation (AC).
   - EE-KIT2. Grid Connection Inverter Kit.

3. **EESFC/CIB. Control Interface Box:**
   - With process diagram in the front panel. The unit control elements are permanently computer controlled. Simultaneously 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. Shield and filtered signals to avoid external interferences. Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Open control allowing modifications, at any moment and in real time, of parameters involved in the process. 3 safety levels: mechanical in the unit, electronic in the control interface and the third one in the control software.

4. **DAB. Data Acquisition Board:**
   - PCI Data acquisition board (National Instruments) to be placed in a computer slot. 16 Analog inputs. Sampling rate up to: 250 Ks/s. 2 Analog outputs. 24 Digital Inputs/Outputs.

5. **EESFC/CCSOF. Computer Control+Data Acquisition+Data Management Software:**
   - Flexible, open and multicontrol software. Management, processing, comparison and storage of data. Sampling velocity up to 250 Ks/s (kilo samples per second). It allows the registration of the alarms state and the graphic representation in real time.

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

7. **Manuals:** This unit is supplied with 8 manuals.

**Dimensions (approx.)**
- Unit: 2200 x 1200 x 2005 mm. Weight: 300 Kg.
- Control Interface: 490 x 330 x 310 mm. Weight: 10 Kg.


**PRACTICAL POSSIBILITIES**

1. Determination of the typical parameters of the solar panels.
2. Study of the existing relation between generated power and power of solar radiation.
4. Study of the influence of the temperature on the tension of circuit opened of the solar panels.
5. Study of the behaviour of the solar panels connected in parallel.
7. Study of the behaviour of the system connected in parallel depending on temperature.
8. Lamps illumination profile study.
10. Influence of the angle of incidence on the temperature.
11. Determination of the material that makes up the solar cell.
12. Determination of the p and n side of a solar cell.
14. Determination of the inverse current or the saturation current with regard to a solar cell without illumination.
15. Determination of the resistance in series and in parallel of a solar cell without illumination.
16. Dependence of the voltage of open circuit (Voc) with the lumens.
17. Determination the characteristic parameters of a solar cell with illumination.
18. Relation of the maximum power with the power input.
19. Determination of the parameters that define the quality of a solar cell.
20. Solar energy measurement.
22. Determination of the cells disposition in a solar panel.
23. Measurement of the maximum power for a solar panel with load.
24. Measurement of the solar panel voltage in vacuum with constant illumination and different temperature.
25. Study of V, I, W according to different loads.
26. Familiarization with the regulator parameters.
27. Study of functionality of the photovoltaic system series/parallel with connection of different loads and without the support of the storage battery.
28. Study of functionality of the photovoltaic system series/parallel with connection of different loads DC, and with the support of the storage battery.
29. Connection of loads to direct voltage.
30. Sensors calibration.
31. Study of functionality of the photovoltaic system series/parallel with connection of different loads and without the support of the storage battery.
32. Study of functionality of the photovoltaic system series/parallel with connection of different loads AC, and with the support of the storage battery.
33. Connection of loads to alternating voltage of 220V.
34. Study of the grid utility inverter.
35-53. Practices with PLC.
MINI-EESF: Photovoltaic Solar Energy Modular Trainer (Complete version)

SPECIFICATIONS SUMMARY
Photovoltaic Solar Energy Modular Trainer 'MINI-EESF', is a laboratory scaled unit designed to study all the parameters governing the Solar radiation direct conversion into electricity. The trainer is based on some application modules and photovoltaic solar panels assembled in mobile structures. It is specially designed for the theoretical and practical study of the electrical installations with photovoltaic solar energy, the typical configurations used in photovoltaic installations and the operation of the different elements involved in the conversion.

Main features:
- Supply and Consumption at 12 V (DC).
- Supply and Consumption in alternating current (AC).
- Supply to the public network (grid).

Photovoltaic module:
- Solar Panel (polycrystalline) mounted on an anodized aluminum structure with wheels for mobility, and with calibrated cell to measure solar irradiation.
- Battery.
- Set of interconnection cables.
- Anodized aluminum framework for modules allocation.

Modules:
- ES10. Solar charge controller with an automatic recognition for operating voltage 12 V or 24 V. It monitors several parameters such as voltage, current and charge level of the battery, load current and status, accumulative values, etc.
- ES20. Loads module that incorporates two 12 V, 50W lamps, with independent switches.
- ES30. DC/AC inverter that outputs a sinewave shaped output of 230V/50Hz ± 2% (or 115V/60Hz ± 3%) and the nominal input voltage is 12Vdc. Two different operating modes: continuous mode and ASB mode (Auto Standby) to reduce the power consumption.
- ES40. AC Voltage measurements module until 250V and DC until 250V.
- ES50. Loads module that incorporates two lamps of 220V or 110V, 50 W., with independent switches.
- ES80. Module for measurements of solar irradiation (W/m²) and measurements of current until 10 A.
- ES90. Module for 12Vdc battery charger.
- EE-KIT2. Grid Connection Inverter Kit. It is formed by Grid Connection Inverter and Energy Generation Simulator.
  - Inverter used for the conversion and injection to the grid of the power generated by a simulated source of renewable energy. The simulated source is a simulator used to obtain a variable power to be injected to the grid.
  - It is equipped with extensive safety measures to ensure that it switches off immediately as soon as the AC plug is removed from the wall socket or the public grid fails in operation.
  - The inverter can be connected to a PC through RS232 communication to display some parameters such as voltage and current inputs, mains voltage and frequency, maximum AC power, Kwh, etc.

Cables and Accessories, for normal operation.
- Manuals: This unit is supplied with 8 manuals.
- Dimensions (approx.):
  - Framework with modules: 1300 x 370 x 750 mm.
  - Weight: 35 Kg.
  - Photovoltaic module: 730 x 510 x 1 150 mm. Weight: 10 Kg.
  - Grid Connection Inverter Kit: 490 x 330 x 410 mm.
  - Weight: 15 Kg.

Other available versions:


PRACTICAL POSSIBILITIES
1. Determination of the constituent material of the solar cell.
2. Determination of the I-V first quadrant curve without illuminating the solar cell.
3. Determination of the inverse (or saturation) current of the cell without illumination.
5. Dependency of the open circuit voltage (Voc) with lumens (luminous flux).
6. Determination of the parameters that describe the quality of a solar cell.
7. Solar energy measurement.
8. Measurement of the solar panel voltage with no load.
10. Familiarisation with the regulator parameters.
11. Loads connection to 12 Volts DC.
12. Loads connection to 220 Volts AC.
13. Study of the grid utility inverter.
Unit: EESFC. Photovoltaic Solar Energy Unit

Key features:

- Advanced Real-Time SCADA.
- 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 CAL software helps the user perform calculations and comprehend the results.
- 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.

For more information about Key Features, click here:
The sun provides a wide spectrum of solar power. With the exception of the light we see around us every day, the rest of the solar power is invisible. Other parts of the spectrum consist of cosmic beams, gamma rays, x-rays, ultraviolet light, infrared light, radio waves and heat. Solar radiation is a form of energy that can be transformed into other types of usable energy: electric, calorific, etc. The systems that carry out this transformation belong to a set of new clean technologies, which do not harm the environment. The direct conversion of light energy into electrical energy is known as photovoltaic effect.

**INTRODUCTION**

The Computer Controlled Photovoltaic Solar Energy Unit (EESFC) includes equipment that uses the photo-conversion law for the direct conversion of solar radiation into electricity. The absorbed energy is provided by simulated solar radiation, which in our case is supplied by a panel with powerful light sources (solar lamps).

The unit contains:
- Photovoltaic solar panels.
- Solar simulator composed of solar lamps.
- Ventilation system.
- DC load and battery charger regulator.
- Auxiliary battery charger.
- Battery.
- DC Loads module.
- Sensors (temperature, light radiation, DC current and DC voltage).

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 Management Software Packages, for controlling the process and all parameters involved in the process.

**Optional (NOT included in the minimum supply):**
- **EE-KIT.** Kit of Conversion and Consumption Simulation (AC):
  - Single-phase inverter.
  - AC Loads Module:
    - 3 Lamps, 1 axial compact fan with plastic guards and 4 positions selector.
    - AC voltage and current sensors.
- **EE-KIT2.** Grid Connection Inverter Kit:
  - Grid Connection Inverter.
  - Grid Simulator (ESR).

**GENERAL DESCRIPTION**

**PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION**

![Diagram of the Computer Controlled Photovoltaic Solar Energy Unit (EESFC) with various components labeled, including photovoltaic solar panels, solar simulator, ventilation system, and control elements.](www.edibon.com)
With this unit there are several options and possibilities:
- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9, 10, 11 and 12.
Let us describe first the main items (1 to 6):

1. **EESFC Unit**:
   - The “EESFC” unit is a computer controlled unit for the study of the conversion of solar energy into electric energy.
   - Anodized aluminum structure and panels in painted steel.
   - Diagram in the front panel with similar distribution to the elements in the real unit.
   - This unit includes wheels for its mobility.
   - The unit includes:
     - Two photovoltaic solar panels (polycrystalline):
       - Tempered glass modules with high level of transmissivity.
       - Encapsulating material: modified ethylene-vinyl acetate.
       - Output nominal power: 66W.
       - Area of the panel: 0.51 m².
       - Max. current: 3.76 A. Max. voltage: 17.53 V.
       - 36 cells, 156 x 156 mm each.
     - Solar simulator composed of:
       - Aluminum frame.
       - 8 Halogen lamps of 400W each one, distributed into two independent voltage regulated circuits.
       - Electrically safe.
     - Ventilation system, computer controlled, that allows to analyze the temperature influence on the unit operation, formed by:
       - 4 Axial compact fans with plastic guards.
     - DC load and battery charger regulator:
       - It regulates how power generated in the photovoltaic solar panels is distributed to and from the auxiliary battery and to the load. A display informs about the state of the charge, operating parameters and fault messages. The functions of the electronic protection are:
         - Overvoltage disconnection, short circuit protection of load and module, overvoltage protection at module input, over-temperature and overload protection, and battery overvoltage shutdown.
     - Auxiliary battery charger:
       - It carefully assesses the battery and then delivers the optimum charge required.
     - Battery:
       - Nominal voltage: 12V. Rated capacity (20 hours rate): 24A/H.
     - DC loads module:
       - Metallic box with diagram on the front panel.
       - 2 Lamps of 24V.
       - One DC motor: voltage: 36V, power: 5W.
       - Rheostat of 500W.
     - Independent connection for every load with the help of the 4 positions selector:
       - Solar panels work at open-circuit.
       - Rheostat and lamps are connected directly to the solar panels. These loads can be connected individually or in parallel with the aid of manual switches.
     - The DC motor is directly connected to the solar panels.
     - The DC load is disconnected and the solar panels are directly connected to the charge regulator.
     - Sensors:
       - Solar radiation sensor to study the behaviour of solar photovoltaic panels.
       - 3 “J” type temperature sensors to measure the environmental temperature, the temperature in the solar panel no. 1 and the temperature in the solar panel no. 2.
     - DC current sensor and DC voltage sensor. The value of DC power can be visualized with the software.
     - The connection of solar panels in parallel or series, the measurement of the voltage and the current before or after the regulator and the regulation of the light intensity of lamps of the two independent circuits are computer controlled.

   The unit includes four blinds to reduce a direct visual contact with the halogen lamps and to reduce the direct contact with the photovoltaic solar panels when the unit is working.

   The complete unit includes as well:
   - Advanced Real-Time SCADA.
   - 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 CAL software helps the user perform calculations and comprehend the results.
   - 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.

Optional (NOT included with the minimum supply): See the “Optional” section on page 6.
- EE-KIT, Kit of Conversion and Consumption Simulation (AC):
  - Single-phase inverter.
  - AC Loads module:
    - 3 lamps, 1 axial compact fan with plastic guards and 4 positions selector.
  - AC voltage and current sensors.
- EE-KIT2, Grid Connection Inverter Kit:
  - Grid Connection Inverter.
  - Grid Simulator (ESR).

EESFC Unit
EESFC/CIB. Control Interface Box:
The Control Interface Box is part of the SCADA system. Control interface box with process diagram in the front panel 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 computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Real time computer control for pumps, compressors, resistances, control valves, etc. Real time computer control for parameters involved in the process simultaneously. 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.
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/O. 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/O. 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.
EESFC/CCSOF. 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. 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.
Cables and Accessories, for normal operation.
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: EESFC + EESFC/CIB + DAB + EESFC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.
EE-KIT. Kit of Conversion and Consumption Simulation (AC):

- **Single-phase inverter:**
  - Single-phase.
  - 25 kHz switch mode technology.
  - Start-up power of 200%.
  - Short-circuit protection.
  - High temperature protection.
  - Overcharge protection.
  - Operation state indicating LED.
  - Rear connection/disconnection switch.

- **AC Loads Module:**
  - Metallic box.
  - Diagram in the front panel.
  - Axial compact fan of 230V with plastic guards.
  - 3 Lamps of 220V - 240V, power: 11W.
  - Independent connection for every load with the help of the 4 positions selector:
    - Inverter operation with no load.
    - Fan motor connected.
    - One AC lamp connected.
    - Two AC lamps connected in parallel.

- **AC voltage and current sensor:** The value of AC power can be visualized with the software.

EE-KIT2. Grid Connection Inverter Kit:

Inverter used for the conversion and injection to the grid of the power generated by a simulated source of renewable energy. The simulated source is a simulator used to obtain a variable power to be injected to the grid.

The operation mode is displayed by means of an indicating LED at the front side of the housing.

It is equipped with extensive safety measures to ensure that it is immediately switched off as soon as the AC plug is removed from the wall socket or the operation of the public grid fails.

The inverter can be connected to a computer (PC) through a RS232 communication to display some parameters, such as voltage and current inputs, mains voltage and frequency, maximum AC power, Kwh, etc.

- **Grid Connection Inverter:**
  - Input (DC):
    - Nominal power @ 25°C: 150 W.
    - Maximum power @ 25°C: 220 W.
    - MPP voltage: 45-125V DC.
    - Maximum voltage: 155V DC.
    - Nominal current: 3A.
  - Output (AC):
    - Maximum power, fuse: 2.25 A.
    - Frequency: 50 Hz (49.8 ~ 50.2 Hz).

This unit is supplied with the Grid Simulator (ESR), which simulates a low power grid to inject the power generated by the inverter.

- **Grid Simulator (ESR):**
  - ESR is designed to create an isolated low power grid. The unit uses a battery as voltage source and generates a sine signal of 220V/50Hz.
  - The main features of the ESR are:
    - Inlet voltage source: battery of 12Vdc.
    - Output: 220V/50Hz.
    - Isolation transformer.
    - Battery charger included.
    - Protection fuses.

The user can work with this module safely. The devices included in the EE-KIT2 can be used worldwide.
1.- Identification and familiarization with all components of the unit and how they are associated with its operation.
2.- Determination of the solar panel characteristic parameters.
3.- Study of the materials that make up the solar cell.
4.- Study of the p and n sides of a solar cell.
5.- Study of the I-V and P-V curves.
6.- Study of the inverse current or the saturation current.
7.- Study of V, I and W according to different loads.
8.- Measurement of the open-circuit voltage and the short-circuit current for a solar panel with load.
9.- Measurement of the maximum power for a solar panel with load.
10.- Study of the relationship between power generated and solar radiation power.
11.- Study of the solar panel maximum power.
12.- Study of the influence of temperature on the solar panel open-circuit voltage.
13.- Determination of the photo-conversion efficiency.
14.- Study of the efficiency of the solar panels connected in parallel.
15.- Study of the efficiency of the solar panels connected in series.
16.- Study of the efficiency, depending on the temperature, of the photovoltaic system connected in parallel.
17.- Study of the operation of the photovoltaic generation system supplying power to different DC loads without an auxiliary battery.
18.- Study of the photovoltaic power generation system operation with an auxiliary battery and supplying different DC/AC loads.
19.- Study of the operation of the photovoltaic system in series/parallel with connection of different loads and without the support of the storage battery.
20.- Study of the operation of the photovoltaic system in series/parallel with connection of different loads DC and with the support of the storage battery.
21.- Sensors calibration.
22.- Lamps illumination profile study.
23.- Determination of the resistance of a solar cell connected in series and in parallel.
24.- Study of the parameters that define the quality of a solar cell.
25.- Study of the dependence of the voltage of open circuit (V∞) on the luminos.
Practices to be done with the OPTIONAL KIT “EE-KIT”:
26.- Study of the operation of the photovoltaic system in series/parallel with connection of different loads and without the support of the storage battery.
27.- Study of the operation of the photovoltaic system in series/parallel with connection of different AC loads and with the support of the storage battery.
28.- Study of the connection of loads to an alternating voltage of 220V.
Practices to be done with the OPTIONAL KIT “EE-KIT2”:
29.- Study of the inverter connected to the grid simulator.
Other possibilities to be done with this Unit:
30.- Many students view results simultaneously.
   To view all results in real time in the classroom by means of a project or an electronic whiteboard.
31.- Open Control, Multicontrol and Real Time Control.
   This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc., in real time.
32.- The Computer Control System with SCADA allows a real industrial simulation.
33.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
34.- This unit can be used for doing applied research.
35.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
36.- Control of the EESFC unit process through the control interface box without the computer.
37.- Visualization of all the sensors values used in the EESFC unit process.
   - By using PLC-PI additional 19 more exercises can be done.
   - Several other exercises can be done and designed by the user.

**REQUIRED SERVICES**

- Electrical supply: three phase, 380V/50Hz, 220V/60Hz, and minimum power 5 kVA.
- Computer (PC).

**DIMENSIONS & WEIGHTS**

| EESFC: | Unit: Dimensions: 2200 x 1200 x 2005mm. approx. (86.61 x 47.24 x 78.93 inches approx.) | Weight: 300 Kg. approx. (661 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.) |

**OPTIONAL**

- EE-KIT. Kit of Conversion and Consumption Simulation (AC):
  Single-phase inverter.
  AC Loads Module:
  3 Lamps, 1 axial compact fan with plastic guards and 4 positions selector.
  AC voltage and current sensors.
- EE-KIT2. Grid Connection Inverter Kit:
  Grid Connection Inverter.
  Grid Simulator (ESR).
- PSA/PC. Polycrystalline photovoltaic solar panel. (2 units)
- PSA/MC. Monocrystalline photovoltaic solar panel. (2 units)
- PSA/AM. Amorphous photovoltaic solar panel. (2 units)

**AVAILABLE VERSIONS**

- EESFC. Computer Controlled Photovoltaic Solar Energy Unit.
- EESFB. Photovoltaic Solar Energy Unit.

(www.edibon.com)
Main software operation possibilities.

Sensors displays, real-time values, and extra output parameters. Sensors:
- ST: Temperature sensor
- SRL: Radiation sensor
- I_DC: DC current sensor
- V_DC: DC voltage sensor
- SW DC-1: DC power measurement
- With optional EE-KIT: I_AC: AC current sensor
- V_AC: AC voltage sensor
- SW AC-1: AC power measurement

Actuators controls. Actuators:
- Serial/Paral: Selector for the connection of photovoltaic solar panels in series or in parallel.
- MEAS: Selector for the measurement of the voltage and the current before or after the regulator.
- FAN: Ventilation system On/off.
- SUN-1: Light intensity regulator (lamps of the circuit no. 1).
- SUN-2: Light intensity regulator (lamps of the circuit no. 2).

Channel selection and other plot parameters.
Real-time graphics displays.

Software for Sensors Calibration

By using a free of charge code, the teacher and the students can calibrate the unit.

The teacher can recover his/her own calibration by using the EDIBON code that we give free of charge.
This screen shows the different values of DC voltage versus the values of DC current of the electricity obtained with the two photovoltaic solar panels connected in parallel.
Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 12. All these items try to give more possibilities for:

a) Industrial configuration. (PLC)

b) Technical and Vocational Education configuration. (CAI and FSS)

c) Higher Education and/or Technical and Vocational Education configuration. (CAL)

d) Multipost Expansions options. (Mini ESN and ESN)

a) Industrial configuration

PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

- PLC-PI. PLC Module:

  Metallic box.

  Circuit diagram in the module front panel.

  Front panel:

  Digital inputs(X) and Digital outputs (Y) block:
  - 16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).
  - 14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

  Analog inputs block:
  - 16 Analog inputs (-10 V to + 10 V) (through SCSI connector).

  Analog outputs block:
  - 4 Analog outputs (-10 V to + 10 V) (through SCSI connector).

  Touch screen:

  Back panel:
  - Power supply connector. Fuse 2A. RS-232 connector to PC. USB 2.0 connector to PC.
  - Inside:
    - Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

  Panasonic PLC:
  - High-speed scan of 0.32 \( \mu \)sec. for a basic instruction.
  - Program capacity of 32 Ksteps, with a sufficient comment area.
  - Power supply input (100 to 240 V AC).
  - DC input: 16 (24 V DC).
  - Relay output: 14.
  - High-speed counter.
  - Multi-point PID control.

  Digital inputs/outputs and analog inputs/outputs Panasonic modules.

  Communication RS232 wire to computer (PC).

  Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.). Weight: 30 Kg. approx. (66 pounds approx.).

- EESFC/PLC-SOF. PLC Control Software:

  For this particular unit, always included with PLC supply.

  The software has been designed using Labview and it follows the unit operation procedure and linked with the Control Interface Box used in the Computer Controlled Photovoltaic Solar Energy Unit (EESFC).

Practices to be done with PLC-PI:

1.- Control of the EESFC unit process through the control interface box without the computer.

2.- Visualization of all the sensors values used in the EESFC unit process.

3.- Calibration of all sensors included in the EESFC unit process.

4.- Hand on of all the actuators involved in the EESFC unit process.

5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).

7.- PLC hardware general use and manipulation.

8.- PLC process application for EESFC unit.

9.- PLC structure.

10.- PLC inputs and outputs configuration.

11.- PLC configuration possibilities.

12.- PLC programming languages.

13.- PLC different programming standard languages.

14.- New configuration and development of new process.

15.- Hand on an established process.

16.- To visualize and see the results and to make comparisons with the EESFC unit process.

17.- Possibility of creating new process in relation with the EESFC unit.

18.- PLC Programming exercises.

19.- Own PLC applications in accordance with teacher and student requirements.
b) Technical and Vocational Education configuration

**EESFC/CAI. Computer Aided Instruction Software System.**

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the EESFC/SOF. Computer Aided Instruction Software (Student Software).

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

This complete software package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (EESFC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

**- INS/SOF. Classroom Management Software (Instructor Software):**

The Instructor can:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Generate and print reports.
- Detect student’s progress and difficulties.
- ...and many other facilities.

**- EESFC/SOF. Computer Aided Instruction Software (Student Software):**

It explains how to use the unit, run the experiments and what to do at any moment.

This Software contains:

- Theory.
- Exercises.
- Guided Practices.
- Exams.

For more information see [CAI catalogue](www.edibon.com/products/catalogues/en/CAI.pdf).

**EESFC/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 on 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 annullled.

**On/off faults:**

- Several on/off faults can be included.

For more information see [FSS catalogue](www.edibon.com/products/catalogues/en/FSS.pdf).
Mini Scada-Net Software

Computer Control Software: Computer Control + Data Acquisition + Data Management

EDIBON Mini Scada-Net System

30 Student Posts

LOCAL NET

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

Instructor’s Central Computer

Photovoltaic Solar Energy Unit (EESFC)

Mini Scada-Net Software

Computer Control Software: Computer Control + Data Acquisition + Data Management

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

Note: The Mini ESN system can be used with any EDIBON computer controlled unit.

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use, specifically developed by EDIBON. It is very useful for Higher Education level.

CAL is a class assistant that helps in doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL computes the value of all the variables involved and performs the calculations.

It allows to plot and print the results. Within the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

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

d) Multipost Expansions options

Mini ESN. EDIBON Mini Scada-Net System.

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 on 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 safe time and cost.
- Future expansions with more EDIBON Units.

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

ESN. EDIBON Scada-Net System.

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:
Minimum supply always includes:

1. Unit: EESFC. Photovoltaic Solar Energy Unit.
2. EESFC/CIB. Control Interface Box.
3. DAB. Data Acquisition Board.
4. EESFC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
5. Cables and Accessories, for normal operation.

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

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EESFC. Unit:
The "EESFC" unit is a computer controlled unit for the study of the conversion of solar energy into electric energy. 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 computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Real time computer control for parameters involved in the process simultaneously. 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.

DAB. Data Acquisition Board:
The Data Acquisition board is part of the SCADA system. PCI Express Data acquisition card (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. Sampling rate up to: 250 KS/s (kilo samples per second).

EESFC/CCSF. 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. 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. Calibration & Practices Manuals.

Cables and Accessories, for normal operation.

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 Main Items

1. Identification and familiarization with all components of the unit and how they are associated with its operation.
2. Determination of the solar panel characteristic parameters.
3. Study of the materials that make up the solar cell.
4. Study of the p and n sides of a solar cell.
6. Study of the inverse current or the saturation current.
7. Study of V, I and W according to different loads.
9. Measurement of the maximum power for a solar panel with load.
10. Study of the relationship between power generated and solar radiation power.
11. Study of the solar panel maximum power.
12. Study of the influence of temperature on the solar panel open-circuit voltage.
15. Study of the efficiency of the solar panels connected in series.
16. Study of the efficiency, depending on the temperature, of the photovoltaic system connected in parallel.
17. Study of the operation of the photovoltaic generation system supplying power to different DC loads without an auxiliary battery.
18. Study of the photovoltaic power generation system operation with an auxiliary battery and supplying different DC/AC loads.
19. Study of the operation of the photovoltaic system in series/parallel with connection of different loads and without the support of the storage battery.
20. Study of the operation of the photovoltaic system in series/parallel with connection of different loads DC and with the support of the storage battery.

Additional practical possibilities:

22. Lamps illumination profile study
23. Determination of the resistance of a solar cell connected in series and in parallel.
24. Study of the parameters that define the quality of a solar cell.
25. Study of the dependence of the voltage of open circuit (V∞) on the lumens.

Practices to be done with the OPTIONAL KIT “EE-KIT”:

26. Study of the operation of the photovoltaic system in series/parallel with connection of different loads and without the support of the storage battery.
27. Study of the operation of the photovoltaic system in series/parallel with connection of different AC loads and with the support of the storage battery.
28. Study of the connection of loads to an alternating voltage of 220V.

Practices to be done with the OPTIONAL KIT “EE-KIT2”:

29. Study of the inverter connected to the grid simulator.

Other possibilities to be done with this Unit:

30. Many students view results simultaneously.
   - To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
31. Open Control, Multicontrol and Real Time Control.
   - This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc, in real time.
32. The Computer Control System with SCADA allows a real industrial simulation.
33. This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
34. This unit can be used for doing applied research.
35. This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
36. Control of the EESFC unit process through the control interface box without the computer.
37. Visualization of all the sensors values used in the EESFC unit process.
   - By using PLC-Pi additional 19 more exercises can be done.
   - Several other exercises can be done and designed by the user.
TENDER SPECIFICATIONS (for optional items)

a) Industrial configuration

7 PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):

- PLC-PI. PLC Module:
  Metallic box.
  Circuit diagram in the module front panel.
  Digital inputs (X) and Digital outputs (Y) block: 16 Digital inputs, 14 Digital outputs.
  Analog inputs block: 16 Analog inputs.
  Analog outputs block: 4 Analog outputs.
  Touch screen.
  Panasonic PLC:
  - High-speed scan of 0.32 μsec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.
  - Digital inputs/outputs and analog inputs/outputs Panasonic modules.

- EESFC/PLC-SOF. PLC Control Software:
  For this particular unit, always included with PLC supply.

  Practices to be done with PLC-PI:
  1. - Control of the EESFC unit process through the control interface box without the computer.
  2. - Visualization of all the sensors values used in the EESFC unit process.
  3. - Calibration of all sensors included in the EESFC unit process.
  4. - Hand on of all the actuators involved in the EESFC unit process.
  5. - Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
  6. - Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
  7. - PLC hardware general use and manipulation.
  8. - PLC process application for EESFC unit.
  9. - PLC structure.
  10. - PLC inputs and outputs configuration.
  11. - PLC configuration possibilities.
  12. - PLC programming languages.
  13. - PLC different programming standard languages.
  14. - New configuration and development of new process.
  15. - Hand on an established process.
  16. - To visualize and see the results and to make comparisons with the EESFC unit process.
  17. - Possibility of creating new process in relation with the EESFC unit.
  18. - PLC Programming exercises.
  19. - Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

8 EESFC/CAI. Computer Aided Instruction Software System.
This complete software package consists on an Instructor Software (INS/SOF) totally integrated with the Student Software (EESFC/SOF).

- INS/SOF. Classroom Management Software (Instructor Software):
  The Instructor can:
  - Organize Students by Classes and Groups.
  - Create easily new entries or delete them.
  - Create data bases with student information.
  - Analyze results and make statistical comparisons.
  - Generate and print reports.
  - Detect student’s progress and difficulties.

- EESFC/SOF. Computer Aided Instruction Software (Student Software):
  It explains how to use the unit, run the experiments and what to do at any moment.
  This Software contains:
  - Theory.
  - Exercises.
  - Guided Practices.
  - Exams.

9 EESFC/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 on 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.
c) Higher Education and/or Technical and Vocational Education configuration

**EESFC/CAL. Computer Aided Learning Software (Results Calculation and Analysis)**

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use. CAL is a class assistant that helps in doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices. CAL computes the value of all the variables involved and performs the calculations. It allows to plot and print the results. Within the plotting options, any variable can be represented against any other. Different plotting displays. It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

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

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 on 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.

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 safe 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.
6. All financing options?

6.1 Soft loan conditions.

6.2 Some other financial options.
6. All financing options.

6.1 Soft loans conditions.

**INTEREST**
Approx. 0.2%

**PAYMENT**
Approx. 30 years

**GRACE PERIOD**
Approx. 10 years

**Requirements:**
- Projects agreement between End Customer and EDIBON.
- Priority letter from COUNTRY FINANCIAL INSTITUTION.

**SOFT FINANCING AVAILABLE**

**WARRANTY REQUIRED**

**EDIBON LONG EXPERIENCE**
6.2 Some other financial options.

6.2.1 Public institutions:

a) Projects of more than 1 million €.
   • Soft loans.
   • Commercial loans.
   • Blending.
   • Specific loans for HIPC countries.

b) Projects under 1 million €.
   • EDIBON basket.

6.2.2 Private institutions:

a) Projects of more than 1 million €.
   • Commercial loans (two options).

b) EDIBON basket.

IMPORTANT! In any loan, **ALWAYS THE GUARANTEE IS REQUIRED!!!**
7. Other EDIBON Business Models.

ALL EDIBON Business Models

- “DAY BY DAY” (D/D)
- PROJECTS AND COMPLETE LABORATORIES
- TECHNICAL EDUCATION TURN KEY PROJECTS (TKP)
- EDIBON CLOUD LEARNING (ECL)
- PILOT PLANTS AND CUSTOM MADE UNITS
- COURSES

See our WEB Site: www.edibon.com
Today “Value for Money” is a condition required by most of the Multilateral and Bilateral credit institutions.

Example:

• World Bank, since July 2016.
• Asian Development Bank, since June 2017
• ...and so on
THANK YOU!