Engineering and Technical Teaching Equipment

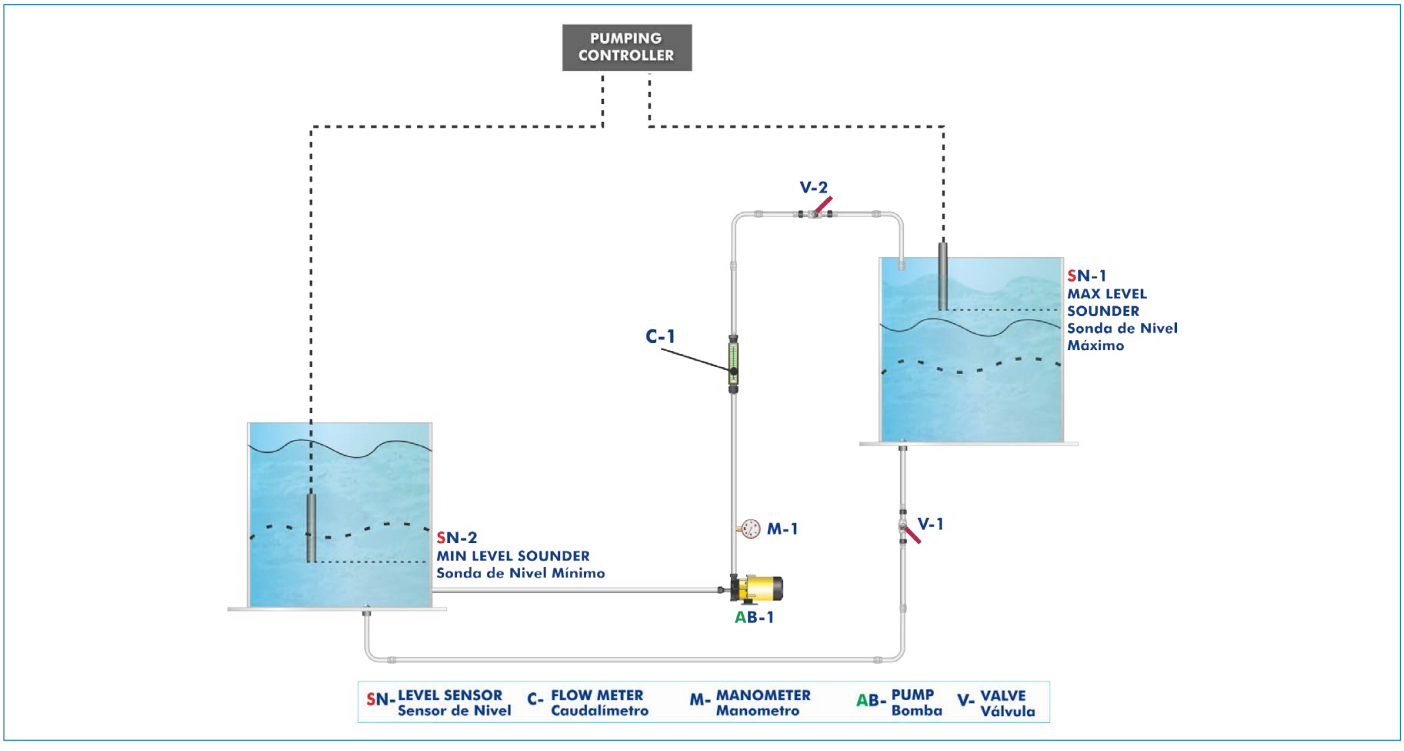
Stand-alone Water Pumping Application

SWP

www.edibon.com
↳PRODUCTS
↳5.- ENERGY

Example of SWP configuration with the recommended kits PV-KIT-300W and WT-KIT-400W

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate (total safety)

Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)

"Worlddidac Quality Charter" and Platinum Member of Worlddidac

INTRODUCTION

Today electricity is essential to provide users with the basic necessities of life. The problem arises when the end user is in places where connection to the electricity grid is not available, such as some rural areas. In these situations, isolated power systems come into play.

Basically these systems consist of energy sources that supply a load. Usually the energy sources are photovoltaic panels, wind turbines or diesel generators. The choice of the type of source to be installed will depend on the wind and sun resources of the site.

In these isolated environments, where the basic requirements of a human are maintained, there is usually no water supply. To solve this problem, wells are dug where water is pumped to the surface and stored in a reservoir, by the action of a boost pump.

GENERAL DESCRIPTION

The Water Pumping Application, "SWP", has been designed by EDIBON to show the user the basic principles of operation of pumping units in isolated networks, exposing in a didactic way the elements involved in the process of generation and pumping. For this purpose, this application consists of two water tanks positioned at different levels; both tanks are communicated by means of a pump and a PVC pipe to reproduce the same conditions as a real pumping system. One of the peculiarities of this application is that it has a manual valve that allows the user to control its opening level. This allows the generation of different manometric pressures at the pump outlet, that is, to define different pumping heights of the installation. Thus, once the user configures the manometric pressure of the installation, the water can be pumped by means of an impulse pump from the lower tank (ground water) to the upper level tank (storage tank).

Permanent Magnet Wind Turbine detail

The pumping application has an industrial pumping regulator specially designed to optimize the energy available for pumping. In hours when solar radiation is minimal, the regulator works on optimizing the current-voltage (I-V) curve to extend the total hours of water pumping. Thus, the student will be able to analyze the operation of these devices and the interest of their installation in systems of these characteristics, in order to adjust the voltage to the nominal operation of the pump.

In addition, the application includes a series of sensors, actuators and indicators to achieve a correct supervision of the installation: flow meter and pressure gauge at pump outlet, stop at maximum level of the upper tank to prevent water overflow, emergency stop at minimum level of the lower tank to prevent the pump from running, various indicators of pump operation and operating switches.

With the multimeters included in the application, the user will be able to visualize the voltage and current at the input and output of the regulator.

In addition, it is recommended to acquire together with the "SWP" application the photovoltaic panel, the wind turbine, the batteries and their corresponding current regulators to demonstrate how a real pumping system works in an isolated network.

In order to acquire a wide knowledge, a specific manual is included in which it is explained, at a theoretical and practical level, the aspects related to photovoltaic and wind water pumping systems, the pumping and irrigation systems (deepening in the architecture of the different units), energy flow analysis and the dimensioning of a solar pumping installation.

The "SWP" application includes the following elements:

- N-ALI02. Domestic Main Power Supply Module.
- N-PLOC. Pumping Local Control Module.
- N-DCPWS-36V/150W. 36 VDC, 150 W Power Supply Module.
- MED65. Digital Multimeter (2 units).
- PTWM. Pumping Unit with Two Water Tanks and Manual Control of Manometric Height.

Additional recommended elements (Not included):

- PV-KIT-300W. 300 W Photovoltaic Kit with Regulator and Measurement Instrumentation.
  - LP6. 6 Lamps Panel with Dimming.
  - N-REG-AC/LR. AC Local/Remote Current Regulator Module.
  - N-MED16. DC Voltmeter Module (0-50 V).
  - N-MED81. DC Ammeter Module (0-30 A).
  - PV-24/300W. Photovoltaic Panel, 24 VDC, 300 W.
  - BAT2. AGM Battery, 25 Ah, 12 V (2 units).
  - N-REG03. MPPT Regulator Module.

  Rack required for the PV-KIT-300W:
    - N-RACK-M.
- WT-KIT-400W. 400 W Wind Turbine Kit with Regulator and Measurement Instrumentation.
  - WT-24V/400W. Permanent Magnets Wind Turbine 24 V, 400 W.
  - N-REG-24V/400W. Wind Turbine Regulator Module 24 V, 400 W.
  - N-TPAD-3PH/400V. 400 V Three-Phase AC/DC Converter Module.
  - N-MED16. DC Voltmeter Module (0-50 V).
  - N-MED81. DC Ammeter Module (0-30 A).
  - BAT2. AGM Battery, 25 Ah, 12 V (2 units).
  - N-SERV400W. 400 W Servomotor Controller Module.

  Rack required for the WT-KIT-400W:
    - N-RACK-M.

SPECIFICATIONS

The "SWP" application includes the following elements:

- N-ALI02. **Domestic Main Power Supply Module.**

  Supply voltage (single-phase): 230 VAC, 1PH + N.

  ON/OFF removable key.

  Output voltage connections:

  Two single-phase: 230 VAC.

  Single-shase supply hose connecting plug.

  Differential magnetothermal, 2 poles, 25 A, 30 mA AC, 6 KA.

  Emergency stop push-button.

N-ALI02

- N-PLOC. **Pumping Local Control Module.**

  Power source input terminals.

  Measurement connectors.

  DC/DC converter.

  Output terminals.

  Remote control LED indicator.

  Maximum level LED indicator.

  Minimum level LED indicator.

  Local control switches.

  Flow meter signal connectors.

  Connectors for variable control (communication signal ports).

  ON/OFF switch.

  Supply voltage of the module: 230 VAC.

  Nominal operating voltage with the pump controller: 36 V.

  DC working voltage range (without pump regulator): 24 – 36 V.

  Peak input power with regulator: 175 W.

  Maximum motor output power: 160 W.

  5 A fuses.

N-PLOC

- N-DCPWS-36V/150W. **36 VDC, 150 W Power Supply Module.**

  LED indicator.

  DC output terminals.

  Auxiliary outlet sockets.

  5 A fuse.

  ON/OFF switch.

  Output voltage: 36 VDC.

  Power: 150 W.

N-DCPWS-36V/150W

- MED65. **Digital Multimeter (2 units).**

  This module has a 3 ½ digit digital multimeter, with 4 mm double connector termination cables to facilitate interconnections.

  With this digital multimeter we can measure:

  Voltage.

  Current.

  Resistance.

  Capacitors capacity.

  Temperature.

MED65

- PTWM. **Pumping Unit with Two Water Tanks and Manual Control of Manometric Height.**

PTWM

  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.
  Pumping tank: 25 l (approx.)
  Accumulation tank: 75 l (approx.)
  Pressure pump.
  Pump voltage: 24 – 36 V.
  Maximum pumping intensity: 4 A.
  Manual valve (V-2).
  Maximum tank level sensor (SN-1).
  Minimum well level sensor (SN-2).
  Manometer of the pipeline (M-1).
  Analogue flow meter.
  Drain valve (V-1).
  Pipes and piping.
  Multimeter.
  AC power cables.

<u>Additional recommended elements</u> (Not included):

- PV-KIT-300W. **300 W Photovoltaic Kit with Regulator and Measurement Instrumentation.**
  - LP6. **6 Lamps Panel with Dimming.**

LP6

    Power: 6 x 500 W.
    Aluminium frame.

  - N-REG-AC/LR. **AC Local/Remote Current Regulator Module.**

N-REG-AC/LR

    16 A fuse.
    Switch for control modes: Local or SCADA.
    ENABLE/DISABLE switch.
    Potentiometer for manual intensity control.
    Current signal control connector.
    ON/OFF switch.
    Power connector.
    Module supply voltage: 230 VAC.
    Working intensity range: 0 – 6.5 A.
    Maximum motor output power: 1500 W.

  - N-MED16. **DC Voltmeter Module (0-50 V).**

N-MED16

    Analogue voltmeter.
    Connection terminals.
    Voltage range: 0 – 50 V.

  - N-MED81. **DC Ammeter Module (0-30 A).**

N-MED81

    Analogue ammeter.
    Connection terminals.
    Intensity range: 0 – 30 A.

- PV-24/300W. **Photovoltaic Panel, 24 VDC, 300 W.**
  - Number of cells: 6 x 12.
  - Maximum power: 335 W.
  - Voltage at maximum power: 38.2 V.
  - Current at maximum power: 8.77 A.
  - Short circuit current (Isc): 9.38 A.
  - Open circuit voltage (Voc): 46.1 V.
  - Module efficiency: 17.2 %.

PV-24/300W

- BAT2. **AGM Battery, 25 Ah, 12 V (2 units).**
  - Nominal voltage: 12 VDC.

BAT2

- N-REG03. **MPPT Regulator Module.**
  - MPPT regulator.
  - ON/OFF switch.
  - Output terminals: 12/24 VDC.
  - Battery terminals: 12/24 VDC.
  - Module power supply: 230 VAC.
  - Nominal discharge current: 20 A.
  - Acceptable DC voltage range: 12 – 50 V.
  - 16 A fuses.
  - Monitoring of parameters:
    - Voltage.
    - Current.
    - Charge level of the battery.
    - Charging current.
    - State.
    - Devices with self-protection, battery and loads.

N-REG03

- WT-KIT-400W. **400 W Wind Turbine Kit with Regulator and Measurement Instrumentation.**
  - WT-24V/400W. **Permanent Magnets Wind Turbine 24 V, 400 W.**
    - Wind turbine.
    - Power: 400 W.
    - Voltage: 24 VDC.

WT-24V/400W

  - N-REG-24V/400W. **Wind Turbine Regulator Module 24 V, 400 W.**
    - 16 A fuses.
    - Wind turbine controller.
    - Three-phase input terminals.
    - ON/OFF switch.
    - Output voltage: 24 – 36 VDC.
    - Battery voltage: 24 VDC.
    - DC output terminals.

N-REG-24V/400W

  - N-TPAD-3PH/400V. **400 V Three-Phase AC/DC Converter Module.**
    - 16 A fuses.
    - Three-phase input terminals.
    - ON/OFF switch.
    - Auxiliary ON/OFF switch.
    - DC output terminals.
    - Input voltage range: 0 – 400 VAC.
    - Output voltage range: 0 – 400 VDC.

N-TPAD-3PH/400V

- N-MED16. **DC Voltmeter Module (0-50 V).**
  - Analogue voltmeter.
  - Connection terminals.
  - Voltage range: 0 – 50 V.

N-MED16

- N-MED81. **DC Ammeter Module (0-30 A).**
  - Analogue ammeter.
  - Connection terminals.
  - Intensity range: 0 – 30 A.

N-MED81

- BAT2. **AGM Battery, 25 Ah, 12 V (2 units).**
  - Nominal voltage: 12 VDC.

BAT2

- N-SERV400W. **400 W Servomotor Controller Module.**
  - Servomotor SERV01.
  - Error LED indicator.
  - 5 A fuse.
  - USB connector.
  - Encoder connector.
  - Power connector.
  - Speed control connector.
  - Switch for control modes: Local or SCADA.
  - ON/OFF switch.
  - Potentiometer for manual speed control.
  - Module supply voltage: 230 VAC.
  - Control speed: 0 – 3000 rpm.
  - Specific frequency: 250 Hz.
  - Operating intensity: 1.5 A.
  - Operating voltage: 101 VAC.

N-SERV400W

- **All necessary cables to realize the practical exercises are included.**

Cables and Accessories, for normal operation.

Manuals:

This unit is **supplied with the following manuals:** Required services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices manuals.

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Starting and stopping the pumping system.

2.- Automatic stop in maximum and minimum level conditions.

3.- Commissioning of the solar pumping system without batteries (requires the PV-KIT-300W).

4.- Commissioning of the solar pumping system with batteries (requires PV-KIT-300W).

5.- Study of the working regime of the pumping regulator: shadow effect (requires the PV-KIT-300W).

6.- Commissioning of the wind pumping system without batteries (requires the WT-KIT-400W).

7.- Commissioning of the wind pumping system with batteries (requires WT-KIT-400W).

8.- Study of the working regime of the pumping regulator: variations of pumped flow (requires the PV-KIT-300W or WT-KIT-400W).

9.- Starting thresholds with and without converter (requires the PV-KIT-300W or the WT-KIT-400W).

10.- Study of the working regime of the pumping regulator: adjustment and reduction of the voltage (requires the PV-KIT-300W or the WT-KIT-400W).

Additional practical possibilities:

11.- Voltage/current measurement at the input and output of the solar regulator.

12.- Comparison of the input and output V/I parameters of the solar regulator and calculation of performance.

13.- Study of the water pump behaviour with and without solar regulator.

14.- Calculation of the power consumption of the pump with and without regulator.

15.- Experimental measurement of the optimal functioning of the pump by means of the use of the flow meter.

- 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, 1 kW.

DIMENSIONS AND WEIGHTS

SWP:

PTWM:

- Dimensions: 1000 x 520 x 960 mm approx. (39.36 x 20.47 x 37.79 inches approx.).
- Weight: 70 Kg approx. (154 pounds approx.).

PV-KIT-300W:

- Dimensions: 2040 x 580 x 1250 mm approx. (80.31 x 22.83 x 49.21 inches approx.).
- Weight: 40 Kg approx. (88 pounds approx.).

WT-KIT-400W:

- Dimensions: 1500 x 580 x 1250 mm approx. (59.05 x 22.83 x 49.21 inches approx.).
- Weigth: 50 Kg approx. (110 pounds approx.).

LP6:

- Dimensions: 1310 x 410 x 850 mm approx. (51.57 x 16.14 x 33.46 inches approx.).
- Weight: 10 Kg approx. (22 pounds approx.).

BAT2:

- Dimensions: 610 x 370 x 340 mm approx. (24.01 x 14.56 x 13.38 inches approx.).
- Weight: 30 Kg approx. (66 pounds approx.).

ADDITIONAL RECOMMENDED ELEMENTS (Not included)

- PV-KIT-300W. 300 W Photovoltaic Kit with Regulator and Measurement Instrumentation.
- WT-KIT-400W. 400 W Wind Turbine Kit with Regulator and Measurement Instrumentation.

SIMILAR UNITS AVAILABLE

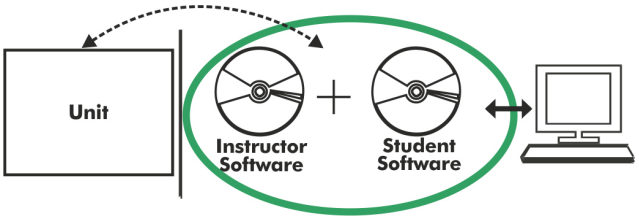
Offered in this catalog:

- SWP. Single Water Pumping Application.

Offered in other catalog:

- SWPC. Computer Controlled Single Water Pumping Application.

SWP/ICAI. Interactive Computer Aided Instruction Software:



With no physical connection between unit and computer, **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.

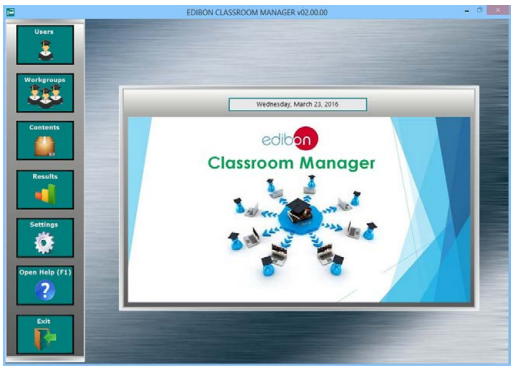
Instructor Software

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

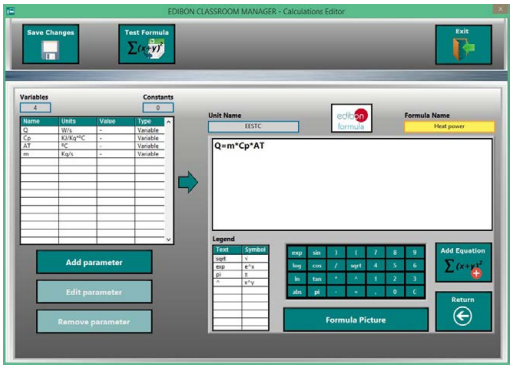
ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual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

Innovative features:

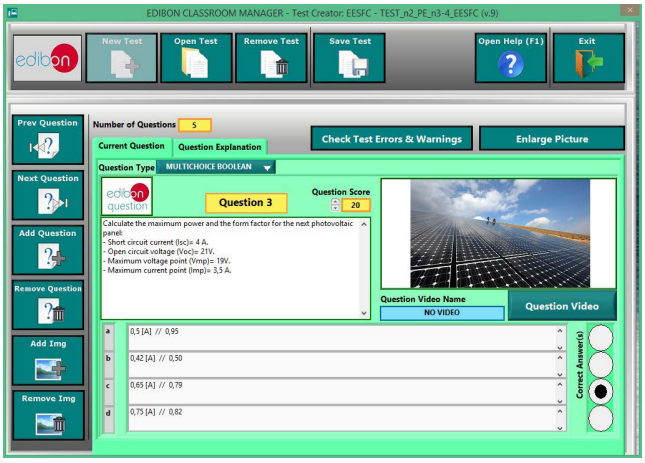
- **User Data Base Management.**
- **Administration and assignment of Workgroup, Task and Training sessions.**
- **Creation and Integration of Practical Exercises and Multimedia Resources.**
- **Custom Design of Evaluation Methods.**
- **Creation and assignment of Formulas & Equations.**
- **Equation System Solver Engine.**
- **Updatable Contents.**
- **Report generation, User Progression Monitoring and Statistics.**



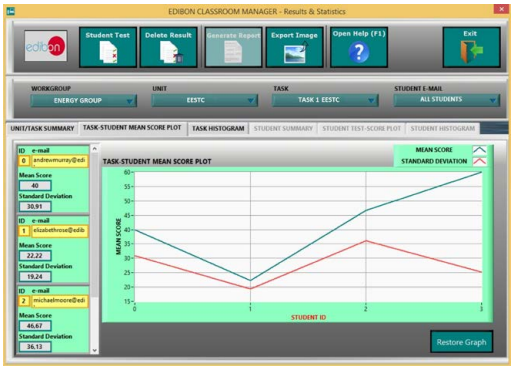
ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen



ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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



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

Optional

Student Software

- 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.

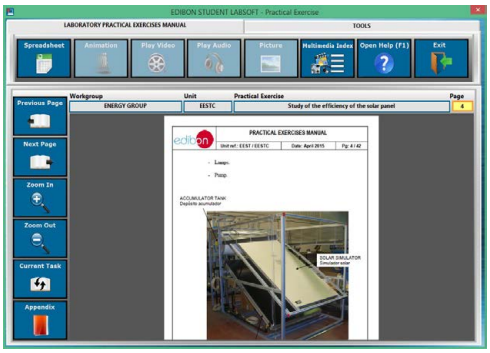
Innovative features:

- **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.**

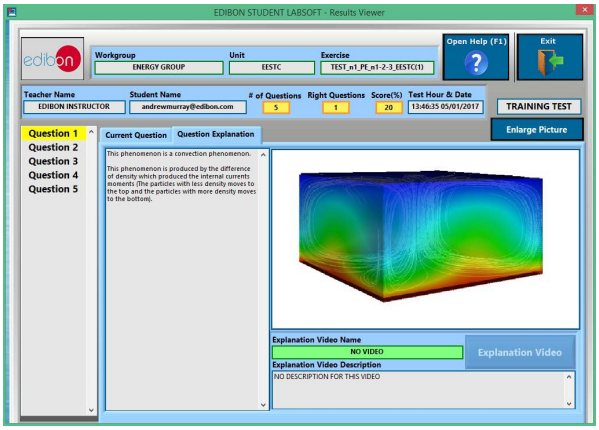
For more information see **ICAI** catalogue. Click on the following link:

www.edibon.com/en/interactive-computer-aided-instruction-software

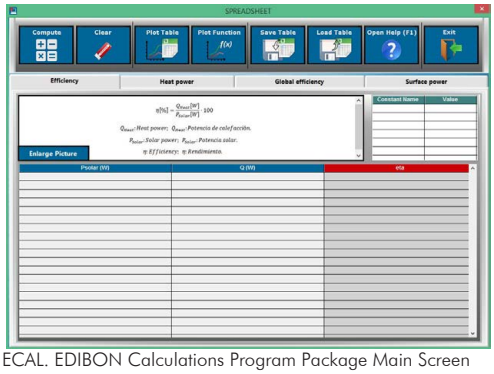
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

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

C/ Julio Cervera, 10-12-14. Móstoles Tecnológico.
28935 MÓSTOLES. (Madrid). ESPAÑA - SPAIN.
Tel.: 34-91-6199363 Fax: 34-91-6198647
E-mail: edibon@edibon.com Web: **www.edibon.com**

Edition: ED02/23
Date: October/2023

REPRESENTATIVE: