Photovoltaic Solar Energy Modular Trainers

edibon

Engineering and Technical
Teaching Equipment

MINI-EESF. **Photovoltaic Solar Energy Modular Trainer** (Complete)

MINI-EESF/M. **Photovoltaic Solar Energy Modular Trainer** (Intermediate)

MINI-EESF/B. **Photovoltaic Solar Energy Modular Trainer** (Basic)

GENERAL DESCRIPTION

Photovoltaic Solar Energy Modular Trainer "MINI-EESF" is a laboratory scaled unit designed to study all the parameters involved in 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.

The power obtained from the solar energy can be:

Regulated to obtain a DC power to charge a battery, studying parameters such as solar module´s current output charge level, battery voltage, etc.

Delivered to DC loads, studying parameters such as solar module´s current output and current consumption by the loads.

Converted to AC power to be delivered to AC loads, studying parameters such as current consumption by the loads.

Injected to the grid, studying parameters such as simulated solar module´s current and voltage outputs, power injected to the grid, mains voltage and frequency, etc.

Three different versions are available with different practical possibilities and levels of difficulty: MINI-EESF, MINI-EESF/M and MINI-EESF/B.

ISO 9001: Quality Management
(for Design, Manufacturing,
Commercialization and After-sales service)
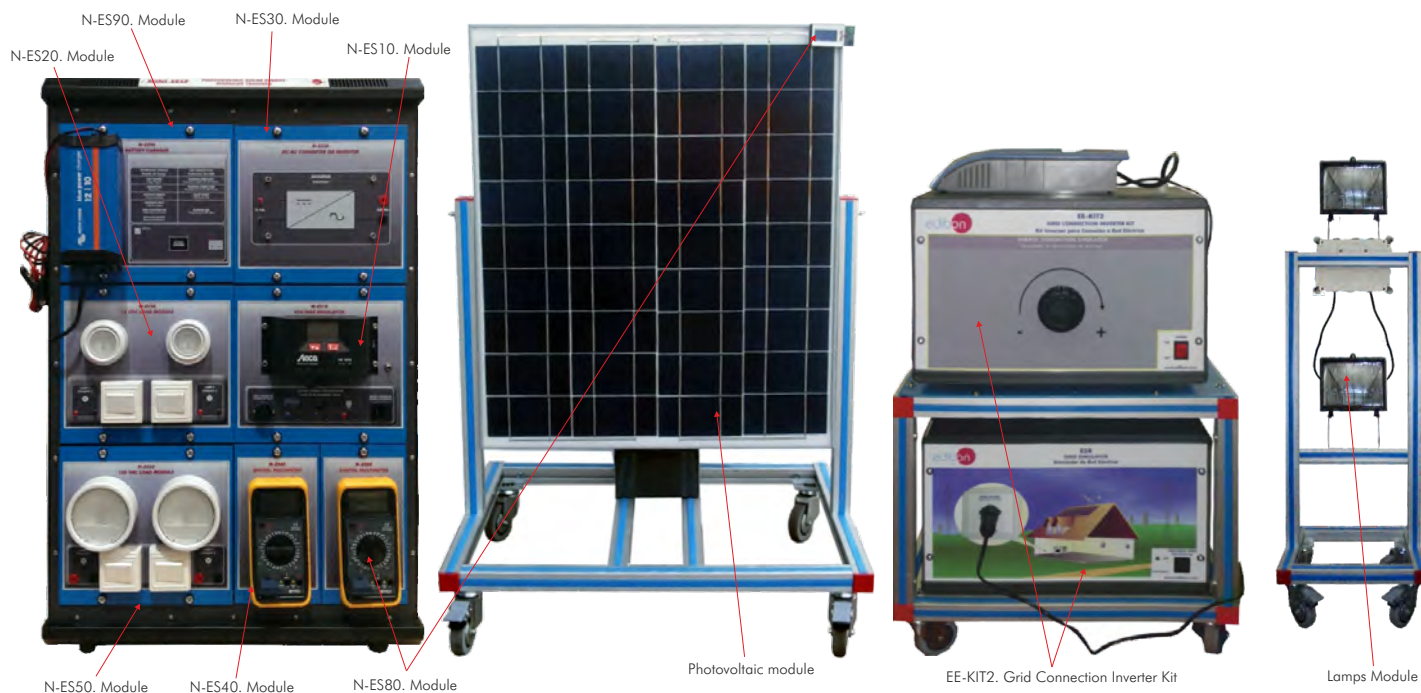
European Union Certificate
(total safety)

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

"Worlddidac Quality Charter"
and Platinum Member of
Worlddidac

Photovoltaic Solar Energy Modular Trainer (Complete)

MINI-EESF

N-ES90. Module
N-ES30. Module
N-ES20. Module
N-ES10. Module

N-ES50. Module
N-ES40. Module
N-ES80. Module

Photovoltaic module

EE-KIT2. Grid Connection Inverter Kit

Lamps Module

SPECIFICATIONS

Main features:

Supply and Consumption at 12 V (DC).

Supply and Consumption in alternating current (AC).

Supply to the 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.

It consists of 36 high performance photovoltaic cells (35 x 55 mm), with a typical power of 50Wp for a 17Vdc voltage.

Both the protections and the used materials give it water proof properties, abrasion protection, hail impact protection and several other adverse environmental factors protection.

Technical data:

Maximum nominal power: 66W.

Voltage at maximum power point (Vmpp): 17.8 V.

Current at maximum power point (Impp): 3.70 A.

Short-circuit current (Isc): 4.05 A.

Open circuit voltage (Voc): 22.25 V.

Dimensions: 660 x 35.5 x 780 mm. Weight: 3 Kg. approx.

Lamps Module:

Composed by two lamps to simulate the sunlight. Regulated Power from 0 to 400 W.

Battery offering optimal performance with low power applications.

Set of interconnection cables.

Rack for modules allocation:

Modules:

N-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, status, etc. Additional functions can be activated such as the settings, night light function and auto-test. The regulator is equipped with various devices to protect its electronics, battery and load.

N-ES20. Loads module that incorporates two 12 V, 20W lamps, with independent switches.

N-ES30. DC/AC inverter that outputs a sinewave shaped output of 230V/50Hz ± 2% and the nominal input voltage is 12Vdc. Two different operating modes: continuous mode and ASB mode (Auto Standby) to reduce the power consumption. It is provided with a diagnosis system to indicate the user the status by different flash sequences.

N-ES40. AC Voltage measurements module until 250V. and DC until 250 V. (digital multimeter).
N-ES50. Loads module that incorporates two lamps of 220V., 50 W., with independent switches.
N-ES80. Module for measurements of solar irradiation (W/m^2) and measurements of current until 10 A., with digital multimeter.
N-ES90. Module for 12Vdc battery charger.
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/USB 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):
  Voltage: 230V (207 - 253 V).
  Maximum power, fuse: 2A.
  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.

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.- 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.
4.- Determination of parallel and series resistance of a solar cell without illumination.
5.- Dependency of the open circuit voltage (V_{oc}) 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.
9.- Determination of the disposition of cells in a solar panel.
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.
14.- Battery charging.
15.- Practices of string (Minimun 2 units MINI-EESF or 1 unit PSA/PC required).

DIMENSIONS & WEIGHTS

MINI-EESF:
  Rack with modules: Dimensions: 645 x 325 x 925 mm. approx. (25.39 x 12.79 x 36.41 inches approx.)
                              Weight: 10 Kg. approx. (22.04 pounds approx.)
  Photovoltaic module: Dimensions: 730 x 510 x 1150 mm. approx. (28.74 x 20.07 x 45.27 inches approx.)
                              Weight: 10 Kg. approx. (22.04 pounds approx.)
  Grid Connection Inverter Kit: Dimensions: 550 x 410 x 820 mm. approx. (21.65 x 16.14 x 32.28 inches approx.)
                              Weight: 30 Kg. approx. (66.13 pounds approx.)

OPTIONAL ELEMENTS

- PSA/PC.   Polycrystalline photovoltaic solar panel.
- PSA/MC.   Monocrystalline photovoltaic solar panel.
- PSA/AM.   Amorphous photovoltaic solar panel.

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

Photovoltaic Solar Energy Modular Trainer (Intermediate)

MINI-EESF/M

N-ES90. Module
N-ES30. Module
N-ES10. Module
N-ES20. Module
N-ES50. Module
N-ES40. Module
N-ES80. Module
Photovoltaic Module
Lamps Module

SPECIFICATIONS

Main features:

Supply and Consumption at 12 V (DC).

Supply and Consumption in alternating current (AC).

Photovoltaic module:

Solar Panel (polycrystalline) mounted on an anodized aluminum structure with wheels for mobility, and with calibrated cell to measure solar irradiation.

It consists of 36 high performance photovoltaic cells (35 x 55 mm), with a typical power of 50Wp for a 17Vdc voltage.

Both the protections and the used materials give it water proof properties, abrasion protection, hail impact protection and several other adverse environmental factors protection.

Technical data:

Maximum nominal power: 66W. Voltage at maximum power point (Vmpp): 17.8 V.

Current at maximum power point (Impp): 3.70 A.

Short-circuit current (Isc): 4.05 A. Open circuit voltage (Voc): 22.25 V.

Dimensions: 660 x 35.5 x 780 mm. Weight: 3 Kg. approx.

Lamps Module:

Composed by two lamps to simulate the sunlight. Regulated Power from 0 to 400 W.

Battery offering optimal performance with low power applications.

Set of interconnection cables.

Rack for modules allocation:

Modules:

N-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, status, etc. Additional functions can be activated such as the settings, night light function and auto-test. The regulator is equipped with various devices to protect its electronics, battery and load.

N-ES20. Loads module that incorporates two 12 V, 20W lamps, with independent switches.

N-ES30. DC/AC inverter that outputs a sinewave shaped output of 230V/50Hz $\pm$ 2% and the nominal input voltage is 12Vdc. Two different operating modes: continuous mode and ASB mode (Auto Standby) to reduce the power consumption. It is provided with a diagnosis system to indicate the user the status by different flash sequences.

N-ES40. AC Voltage measurements module until 250V. and DC until 250 V. (digital multimeter).

N-ES50. Loads module that incorporates two lamps of 220V., 50 W., with independent switches.

N-ES80. Module for measurements of solar irradiation (W/m^2) and measurements of current until 10 A., with digital multimeter.

N-ES90. Module for 12Vdc battery charger.

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.- 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.

4.- Determination of parallel and series resistance of a solar cell without illumination.

5.- Dependency of the open circuit voltage (V_{oc}) 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.

9.- Determination of the disposition of cells in a solar panel.

10.- Familiarisation with the regulator parameters.

11.- Loads connection to 12 Volts DC.

12.- Loads connection to 220 Volts AC.

13.- Battery charging.

14.- Practices of string (Minimun 2 units MINI-EESF/M or 1 unit PSA/PC required).

DIMENSIONS & WEIGHTS

MINI-EESF/M:

Rack with modules:	Dimensions: 645 x 325 x 925 mm. approx. (25.39 x 12.79 x 36.41 inches approx.)
	Weight: 10 Kg. approx. (22.04 pounds approx.)
Photovoltaic module:	Dimensions: 730 x 510 x 1150 mm. approx. (28.74 x 20.07 x 45.27 inches approx.)
	Weight: 10 Kg. approx. (22.04 pounds approx.)

OPTIONAL ELEMENTS

- PSA/PC.   Polycrystalline photovoltaic solar panel.

- PSA/MC.   Monocrystalline photovoltaic solar panel.

- PSA/AM.   Amorphous photovoltaic solar panel.

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

Photovoltaic Solar Energy Modular Trainer (Basic)

MINI-EESF/B

N-ES10. Module

N-ES20. Module

N-ES90. Module

N-ES80. Module

Photovoltaic Module

Lamps Module

SPECIFICATIONS

Main features:

Supply and Consumption at 12 V (DC).

Photovoltaic module:

Solar Panel (polycrystalline) mounted on an anodized aluminum structure with wheels for mobility, and with calibrated cell to measure solar irradiation.

It consists of 36 high performance photovoltaic cells (35 x 55 mm), with a typical power of 50Wp for a 17Vdc voltage.

Both the protections and the used materials give it water proof properties, abrasion protection, hail impact protection and several other adverse environmental factors protection.

Technical data:

Maximum nominal power: 66W. Voltage at maximum power point (Vmpp): 17.8 V.

Current at maximum power point (Impp): 3.70 A.

Short-circuit current (Isc): 4.05 A. Open circuit voltage (Voc): 22.25 V.

Dimensions: 660 x 35.5 x 780 mm. Weight: 3 Kg. approx.

Lamps Module:

Composed by two lamps to simulate the sunlight. Regulated Power from 0 to 400 W.

Battery offering optimal performance with low power applications.

Set of interconnection cables.

Rack for modules allocation:

Modules:

N-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, status, etc. Additional functions can be activated such as the settings, night light function and auto-test. The regulator is equipped with various devices to protect its electronics, battery and load.

N-ES20. Loads module that incorporates two 12 V, 20W lamps, with independent switches.

N-ES80. Module for measurements of solar irradiation (W/m^2) and measurements of current until 10 A., with digital multimeter.

N-ES90. Module for 12Vdc battery charger.

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.- 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.

4.- Determination of parallel and series resistance of a solar cell without illumination.

5.- Dependency of the open circuit voltage (V_{oc}) 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.

9.- Determination of the disposition of cells in a solar panel.

10.- Familiarisation with the regulator parameters.

11.- Loads connection to 12 Volts DC.

12.- Battery charging.

13.- Practices of string (Minimun 2 units MINI-EESF/B or 1 unit PSA/PC required).

DIMENSIONS & WEIGHTS

MINI-EESF/B:
- Rack with modules: Dimensions: 645 x 325 x 670mm. approx. (25.39 x 12.79 x 26.37 inches approx.)
  Weight: 6 Kg. approx. (13.22 pounds approx.)
- Photovoltaic module: Dimensions: 730 x 510 x 1150 mm. approx. (28.74 x 20.07 x 45.27 inches approx.)
 Weight: 10 Kg. approx. (22.04 pounds approx.)

OPTIONAL ELEMENTS

- PSA/PC.   Polycrystalline photovoltaic solar panel.

- PSA/MC.   Monocrystalline photovoltaic solar panel.

- PSA/AM.   Amorphous photovoltaic solar panel.

✳ Specifications subject to change without previous notice, due to the convenience of improvements of the product.

MINI-EESF/ICAI.Interactive Computer Aided Instruction Software System:
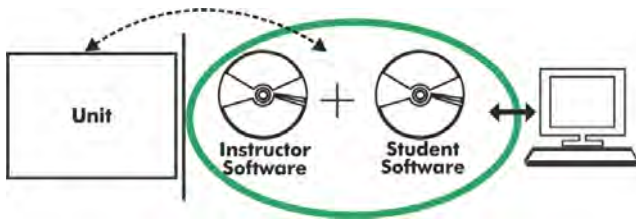
With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF)**. Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.
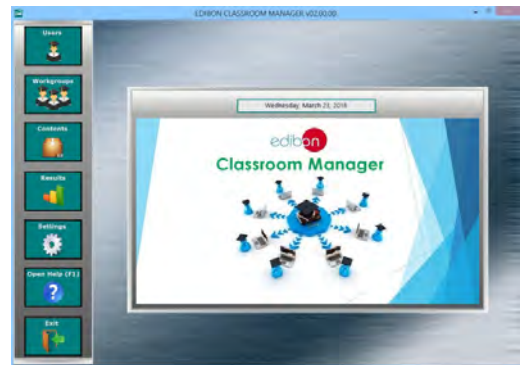
Instructor Software

- 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

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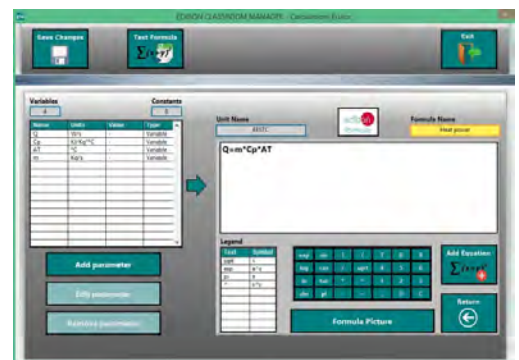
ECAL. EDIBON Calculations Program Package -
Formula Editor Screen

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

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.
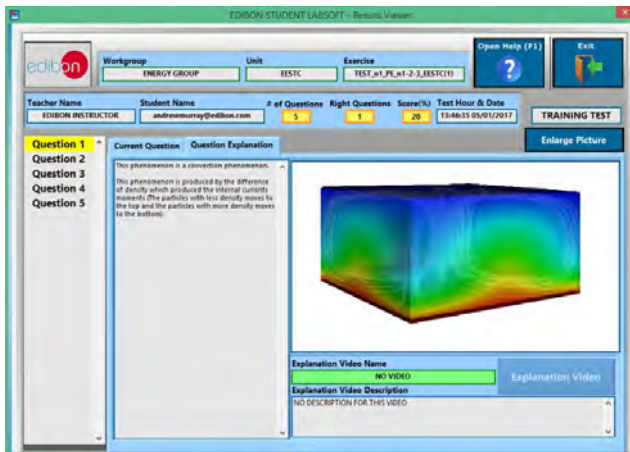- • User Monitoring Learning & Printable Reports.

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

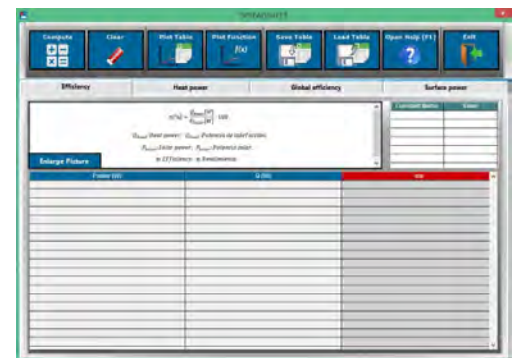www.edibon.com/products/catalogues/en/ICAI.pdf
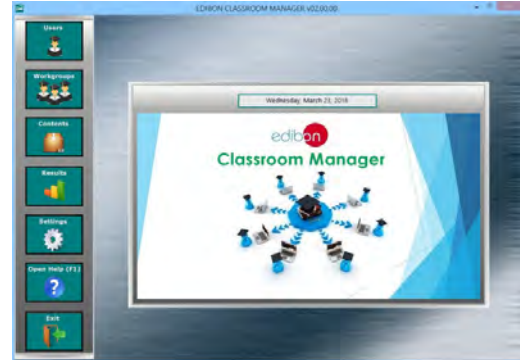
ESL-SOF. EDIBON Student LabSoft (Student Software)
Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation de una pregunta

ECAL. EDIBON Calculations Program Package Main Screen

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