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Power Engineering | Smart Grid | Micro Grid

Training systems on the generation, distribution and management of electrical energy:

- Power engineering training system, distribution training system
- Energy generation training system, renewable energy generation training system
- Transformer training system, high-voltage transmission lines training system, protective systems training system
- Energy management training system, smart grid training systems

The Lucas-Nülle training systems have been designed in anticipation of the newest developments:

- Smart measuring instruments provided with various communication interfaces (e.g. LAN, RS485, USB) and control elements
- SCADA Power Engineering Lab software for the intelligent control and evaluation of "smart grids" using Soft PLC
- SCADA software designed for educational purposes
- Permits investigation of dynamically alternating loads and power generation inside the laboratory
- Intelligent energy management
- Modular integration of renewable energies into a smart grid using protective engineering
- Wind power plant with doubly-fed asynchronous generator (DFIG) and synchronisation to the grid
- Interactive multimedia training course

Renewable Energies

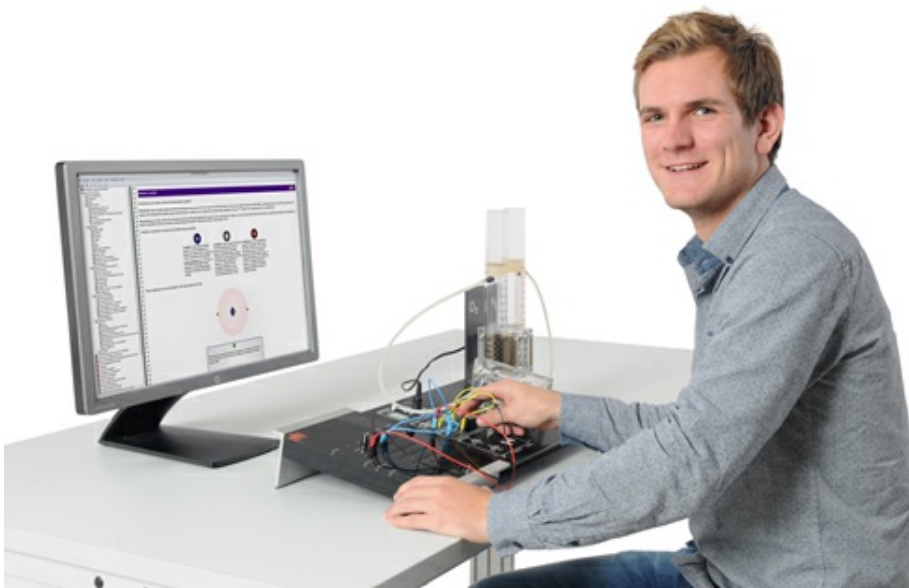


Renewable Energies

The move away from coal, oil and nuclear power to renewable forms of energy is gaining momentum. Today, technology has evolved to a point where solar energy, wind power, hydrogen fuel and biomass can be exploited as environmentally friendly energy sources.

Throughout the world well-qualified technicians and engineers are being sought after to help keep this trend moving forward. Today, technologies are undergoing rapid change. This trend is being compounded by rising expectations in training and education. Lucas-Nülle has developed the appropriate training systems needed to cope with the ever more complex world of training and education.

Fuel cell technology (UniTrain)



Fuel cell technology (UniTrain)

With the UniTrain fuel cell technology course fuel cell operating principles and functions are explained in graphic detail.

UniTrain Energy Engineering course uses numerous experiments and animations to provide insight into current issues affecting electrical power engineering. The various courses cover the generation of electric power from regenerative energies as well as the processes involved in distribution networks. Typical generation and distribution processes requiring special treatment are dealt with and explored in experiments using safe extra-low voltages.

List of articles:

Pos.	Product name	Bestell-Nr.	Anz.
1	Course - Power engineering: Fuel cell technology	CO4204-3C	1

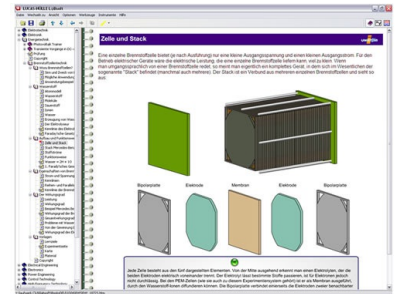
Includes:

Experiment panel with:

- PEM double fuel cell
- PEM electrolyser with scaled gas storage device
- Power supply 2V/ 2.5A
- Consumers
- Hoses, hose clamps
- Variable load for characteristic recording
- CD-ROM with Labsoft browser and course software

Course content:

- Functional and operating principle of fuel cells
- Recording the characteristics of a fuel cell
- Learn to explain the electrochemical processes of electrolysis (Faraday's first and second law)
- Faraday's laws and determining the energy efficiency of a fuel cell
- Series and parallel configuration of fuel cells
- Considerations regarding the power of fuel cells
- Functional and operating principles of electrolysers
- Recording the VI characteristic of the electrolyser
- Faraday's laws and determining the energy efficiency of an electrolyser
- Course duration approx. 4.5 h



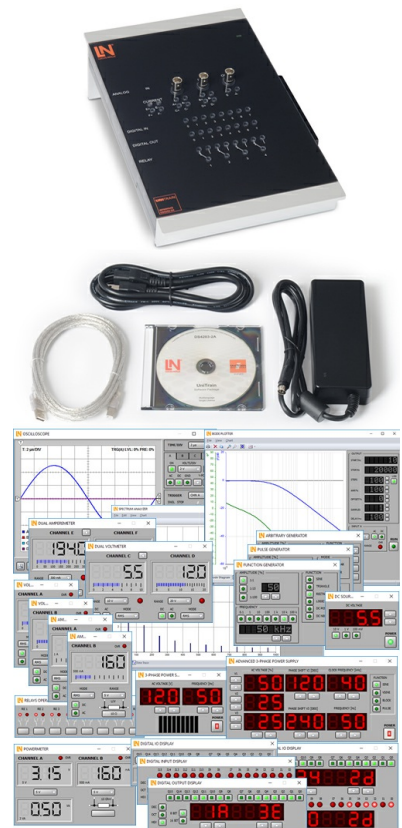
Additionally required:

Pos.	Product name	Bestell-Nr.	Anz.
2	UniTrain Interface with virtual instruments (basic VI)	CO4203-2A	1

The UniTrain Interface is the central unit of the UniTrain system. It incorporates all inputs and outputs, switches, power and signal sources and measurement circuitry needed to perform experiments. The Interface is controlled via the connected PC.

Equipment:

- 32-bit processor with storage memory for measurements
- USB interfaces, transfer rate 12 Mbits/s
- WLAN/WiFi interface, 2.4 GHz, IEEE 802.11 b/g/n
- Simultaneous connection of any number of Experimenters via serial bus system
- High-quality designer casing with aluminium feet and surface-hardened Plexiglas front panel
- Suitable for accommodating in training panel frames for DIN A4 training panels
- Designed for connection of 2-mm safety measuring leads
- Multi-coloured LEDs for displaying status
- Adjustable analog output, +/-10 V, 0.2 A, DC – 5 MHz, via BNC and 2-mm sockets
- 4 Analog differential amplifier inputs with 10 MHz band width, safe for voltages up to 100 V, sampling rate 100 mega samples, 9 measuring ranges, memory depth 4 x 8 k x 10 bits, inputs via BNC (2 inputs) or 2-mm sockets (4 inputs)
- 2 Analog inputs for current measurement, overcurrent-protected up to 5 A, sampling rate 250 kilo samples, 2 measuring ranges, resolution 12 bits, connection via 2-mm sockets
- 3 variable analog outputs +/- 20V, 1 A, DC-150 Hz (requires CO4203-2B)
- 16-bit digital signal output, of which 8 bits are accessed via 2-mm sockets, TTL/CMOS, clock frequency 0 – 100 kHz, electric strength +/- 15 V
- 16-bit digital signal input, of which 8 bits are accessed via 2-mm sockets, memory depth 16 bit x 2 k, TTL/CMOS, sampling rate 0 – 100 kHz, electric strength +/- 15 V,
- 8 Relays, 24 V DC/1 A, of which 4 are accessed via 2-mm sockets
- Dimensions: 29.6 x 19 x 8.6 cm
- External power supply with wide range input 100-264 V, 47-63 Hz, output 24 V/5 A
- Weight (including power supply): 2.1 kg



Virtual instruments (meters and sources):

- 2 x Voltmeter VIs, 2 x Ammeter VIs: AC, DC, 9 ranges, 100 mV to 50 V, true RMS, AV
- 1 x Power meter, 9 ranges, 100 mV to 50 V
- 1 x VI with 8 relays, 1 x Multimeter VI: multimeter display (optional LM2330, LM2331 or LM2322) in LabSoft
- 1 x 2-channel ammeter VI: AC, DC, 2 ranges, 300 mA and 3 A, TrueRMS, AV
- 1 x 2-channel voltmeter VI: AC, DC, 9 ranges, 100 mV to 50 V, TrueRMS, AV
- 1 2-/4-channel oscilloscope: band width 10 MHz, 25 time ranges, 100 ns/div to 10 s/div, 9 ranges 20 mV/div to 10 V/div, trigger and pre-trigger, XY and XT modes, cursor function, addition and multiplication function for 2 channels
- 1 x VI Spectrum Analyzer: 9 voltage ranges 100 mV to 50 V, input frequency range 3 Hz to 1 MHz, time domain display
- 1 X VI Bode-Plotter: 9 voltage ranges 100 mV to 50 V, frequency range 1 Hz - 5MHz, time domain display and locus diagram
- 1 x Adjustable DC voltage VI 0 - 10 V
- 1 x Function generator VI: 0.5 Hz - 5 MHz, 0 - 10 V, sine, square, triangular,
- 1 x Arbitrary generator VI, 1 x Pulse generator VI
- 1 x VI with 16 digital outputs, 1 x VI with 16 x digital inputs, 1 x VI with 16 digital input/outputs. Display modes: binary, hex, decimal and octal numerals
- 1 x Three-phase power supply VI, 0 - 150 Hz, 0 - 14 Vrms, 2 A (requires CO4203-2B)
- 1 x Adjustable DC power supply VI, 3 x (-20 V - +20 V), 2 A (requires CO4203-2B)
- 1 x Three-phase power supply VI with additional phase-shift and clock rate adjustment (requires CO4203-2B)

Includes:

- Interface
- Power supply
- Power lead
- USB cable
- CD with basic software
- Operating manual

System requirements:

- Personal computer with Windows Vista, Windows 7, Windows 8, Windows 8.1, Windows 10 (32 or 64 bit)
- CD-ROM drive for installing software
- USB port for connection to Interface

3 UniTrain measurement accessories, shunts and connection cables

CO4203-2J

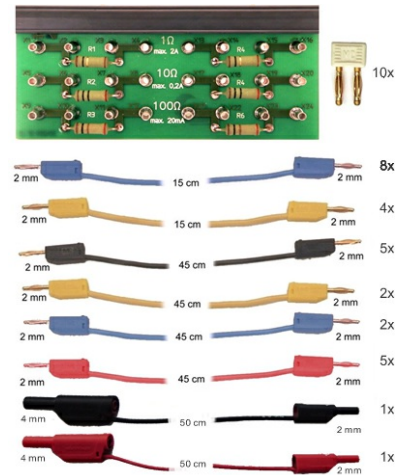
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Shunt resistors on a PCB, for current measurement using the analog inputs of the UniTrain system.

- 6 Shunt resistors: 2 x 1 ohm, 2 x 10 ohm, 2 x 100 ohm
- Screen print of symbols for identifying resistors, the voltage taps and current inputs
- 24 x 2-mm sockets
- Dimensions: 100 x 40 mm

Set of connection cables 2 mm (28 pcs) for UniTrain consisting of:

- 8 x connection leads 2 mm, 15 cm, blue
- 4 x connection leads 2 mm, 15 cm, yellow
- 5 x connection leads 2 mm, 45 cm, black
- 2 x connection leads 2 mm, 45 cm, yellow
- 5 x connection leads 2 mm, 45 cm, red
- 2 x connection leads 2 mm, 45 cm, blue
- 1 x safety adapter lead 4 mm to 2mm, 50 cm, black
- 1 x safety adapter lead 4 mm to 2mm, 50 cm, red
- 10 x 2-mm connector plugs / Plug spacing 5 mm, white



Additionally recommended

Pos.	Product name	Bestell-Nr.	Anz.
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4 **Multi13S digital multimeter**

LM2330

1

Universal precision lab multimeter and temperature meter with IR interface for high-quality, universal measurement and testing in educational settings, power plants, process control installations etc.

- 3¾-digit multimeter; resolution: ±3,100 digits
- Measurement classification CATII-1000 V
- Can be connected to UniTrain system via IR interface
- Voltage and current measuring ranges: 30 mV-1000 V DC, 3 V-1000 V AC; 3 mA-16 A DC; 30 mA-10 A AC
- Resistance ranges: 30 ohm-30 Mohm
- Special functions: °C for temperature measurements using PT100/1000 thermocouple (optional accessory)
- Continuity and diode testing
- Automatic range selection and battery shut-off, min./max. and data hold function
- Safety fuse for current measurement range up to 300 mA
- Protection against high currents in the mA range for nominal voltage of 1000 V
- Display with bar chart and backlighting
- Includes protective sleeve, measuring leads, 1 x spare fuse, 9V battery, calibration certificate



5 **UniTrain storage case for one system**

CO4203-2Y

1

Sturdy aluminium case with moulded foam block to accommodate a complete UniTrain system (without equipment)

- Capable of accommodating 1 Interface, 2 Experimenters, 1 power supply as well as cables and smaller accessories
- Lockable padlock; stable padlock hinge
- Colours: aluminium, black, chrome
- Dimensions: 610 x 480 x 100 mm
- Weight: 4,6 kg



6 UniTrain storage case for experiment board

SO4203-2V

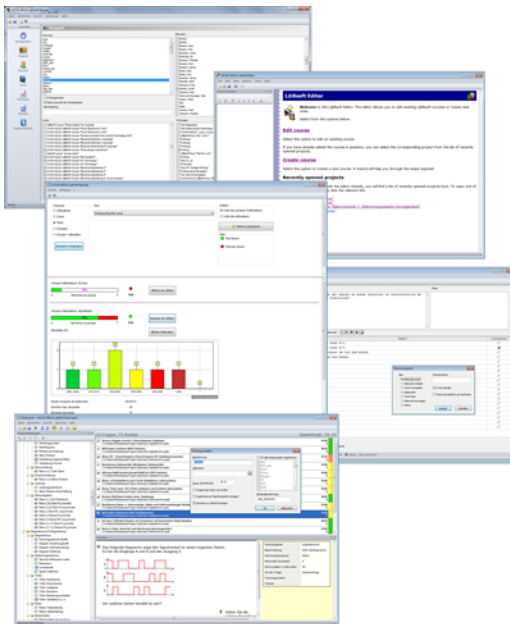
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Sturdy aluminium case with moulded foam block to accommodate an experiment board

- Capable of accommodating 1 experiment board and smaller accessories
- Lockable padlock; stable padlock hinge
- Colours: aluminium, black, chrome
- Dimensions: 600 x 450 x 175 mm
- Weight: 2.5 kg



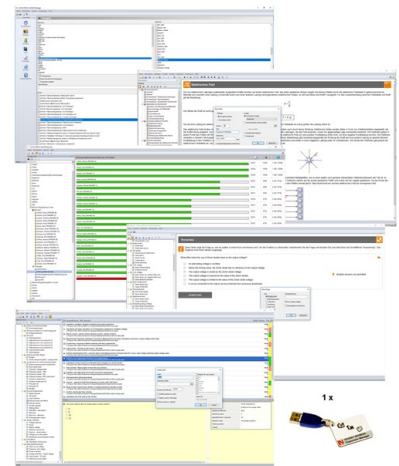
Recommended learning management software for all LN multimedia courses:



Pos.	Product name	Bestell-Nr.	Anz.
7	LabSoft Classroom Manager 5.0 software suite, single license	SO2001-5A	1

LabSoft Classroom Manager is a comprehensive set of administration software for the UniTrain system and all LabSoft courses. Classroom Manager comprises the following independent program components:

- LabSoft Manager: Administration of students and courses in LabSoft
- LabSoft Reporter: Student reports and statistics
- LabSoft Editor: Creation and editing of courses and tests
- LabSoft Questioner: Creation of questions, measuring exercises and sets of questions for courses and tests
- LabSoft TestCreator: Automatic generation of tests on the basis of sets of questions



Features:

- Ease of use of all programs thanks to graphical user interface in all component programs
- For use in local area networks or on stand-alone PC
- Ease of installation
- No additional database software required
- Access control via USB dongle
- Available languages: DE, EN, ES, FR, RU, PT, ZH, LO

LabSoft Manager:

- Administration of LabSoft network installation
- Administration of an unlimited number of students and courses in LabSoft
- Addition, deletion and editing of courses and tests in LabSoft
- Addition, deletion and editing of students and student data
- Addition, deletion and editing of student groups (classes)
- Assignment of students to classes
- Activation of team function in LabSoft
- Assignment of courses and tests to students or classes

LabSoft Reporter:

- Electronic monitoring of student progress
- Graphical presentation of progress in courses and tests
- Presentation of student or group results

- Reports on courses, tests, single users or classes
- Summary of results and time
- Export of data to clipboard or file
- Display and printing of tests which have been taken with the candidate's original answers
- Multiple search options for students, classes, courses or tests

LabSoft Editor:

- HTML editor for easy to use editing of LabSoft courses
- Editing of course pages
- Wizard for creation of new courses and course pages
- Automatic inclusion of new courses in an existing LabSoft installation
- Automatic creation of IMS-compatible navigation tree without the need for programming knowledge
- Moving course pages within the navigation tree at the click of a mouse
- Editing in WYSIWYG mode
- HTML view and page preview
- Insertion of graphics, animations and tables
- Insertion of test questions
- Page templates for a variety of page types

LabSoft Questioner:

- Program for creating and editing questions, practical measuring exercises and sets of questions (question files) for electronic evaluation
- Easy creation of exercises and questions for courses and tests
- 7 different types of question: single and multiple choice, missing text, assignment, matrices, arbitrary text, selection of images
- Ability to input meta data (points, time for questions, difficulty, required resources, etc.)
- Easy specification of tolerances for practical measuring exercises
- Changes to the assessment criteria for courses or tests (including after the test has been taken)

LabSoft TestCreator:

- Program for automatically creating electronic tests from sets of questions (question files)
- Automatic and manual selection of questions and measuring exercises
- Filter functions (e.g.: type of question, difficulty) for pre-selection of questions
- Automatic generation of tests according to a set time or number of questions
- Various test options: arbitrary order of questions in a test, immediate display of results after completion
- Automatic registration of tests in LabSoft
- Preview function showing the test as created

Includes:

- CD-ROM with LabSoft Classroom Manager
- 1 USB-dongle for operation of program

System requirements:

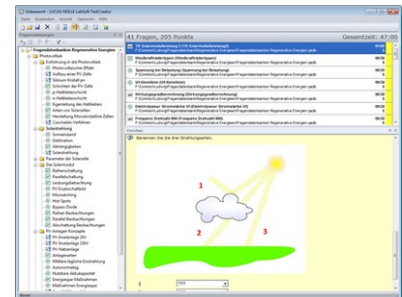
- Server or PC with Windows 7, 8, 8.1 or 10
- Microsoft Internet Explorer 9.0 or higher
- Minimum 200 MB free disk space
- 1 free USB-port for USB-dongle

8 Collection of assignments Power Engineering / Renewable Energies

SO2001-6D

1

Collection of electronic assignments questions and measuring exercises for the UniTrain courses on the topic of electrical power engineering and renewable energies. With the help of Labsoft TestCreator, these questions and measuring exercises can easily be assembled into electronic tests. The tests can then be carried out in LabSoft.



- A total of some 200 questions and measuring exercises for the UniTrain courses on the topics of Photovoltaics, Fuel cell technology, Transient processes in AC and DC networks and the multimedia course Small wind power plant
- About 25% are practical exercises to be carried using the training systems in order to test handling skills and practical abilities
- About 30% are newly assembled questions previously contained in the courses
- It is possible to extend the collection with your own questions and assignments
- Other collections can be imported
- All questions and assignments can be edited
- 6 different types of questions (single choice, multiple choice, missing text, matching, matrix matching and image choice)
- Extensive metadata for all questions and assignments to make it easier to create tests (degree of difficulty, points, topic area, time to complete, type of question, training systems needed for practical exercises)