Table of Contents

UniTrain®

UniTrain is a multimedia e-learning system with integrated, mobile electronics lab for general education and advanced training in electrical engineering and electronics.

UniTrain courses

UniTrain courses

UniTrain electrical machine courses

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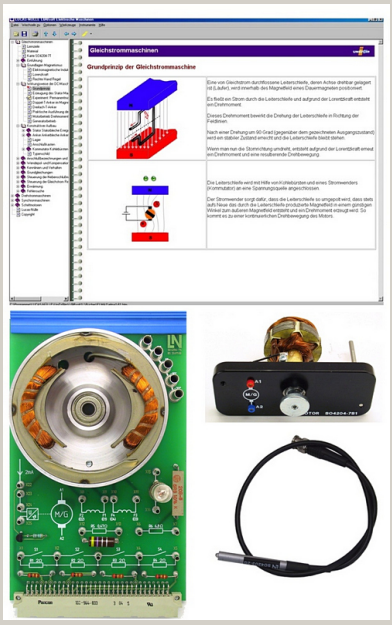
UniTrain multimedia courses on electrical machines encompass the entire spectrum of electrical machines. The motors are characterised by their open, accessible stators. These are built onto experiment cards and thus allow a detailed view of the internal design of electrical machines. In addition, the open design makes it possible to exchange rotors quickly and without tools.

Students taking the course are familiarised with the physical principles, the operation, properties and basic circuitry for various machines. In many experiments the machines are put into operation and their electrical properties measured using multimeters and oscilloscope, control units are set up and the safe usage of electrical machines is reinforced.

List of articles:

Pos.	Product name	Bestell-Nr.	Anz.
1	**Course - Electric Machines 1: DC machines**	SO4204-7S	1



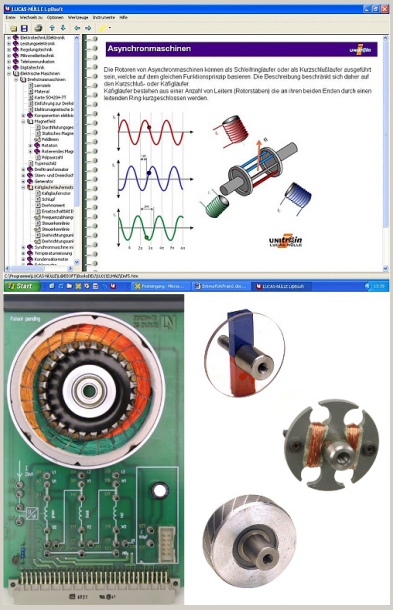
Includes:

- 1 Experiment card with open, 2-pole stator and 2 exciter windings, temperature sensor with voltage source, starting and load resistors
- Rotor with adjustable brushes
- Stroboscope with extra-bright LED
- CD-ROM with Labsoft browser and course software

Course contents:

- Identifying the most common applications for DC machines
- Explanation of electromagnetic induction and the Lorentz force
- Explanation of design and function of commutated machines (DC machines)
- Introduction to the key components of commutated machines, stator, commutator and carbon brushes
- Measurement of current and voltage in armature and exciter and determining the armature and exciter impedances
- Interpreting a rating plate
- Introduction to circuit diagrams and characteristics for various types of connection: series, shunt and compound windings
- Connection and operation of DC machines in various operating modes
- Speed measurement using a stroboscope
- Introduction to various types of speed regulation and reversal: field weakening, modification by means of armature and field resistors
- Experimental investigation of various methods for controlling speed and direction of rotation
- Connection and operation of commutated machines with AC voltages: universal motors
- Introduction to methods of braking DC machines
- Measurement of current and voltage when braking DC machines
- Explain the importance of temperature monitoring for electrical machines
- Temperature measurement in the exciter winding when a machine is running using a semiconductor sensor
- Course duration. 5.5 h approx.

2 **Course - Electric Machines 2: Asynchronous machines** SO4204-7T 1



Includes:

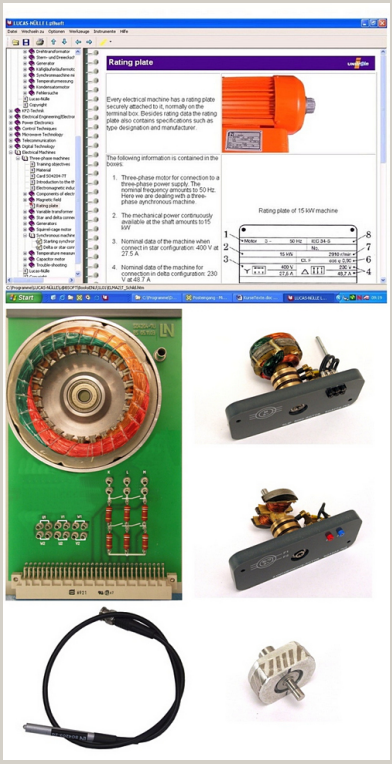
- 1 Experiment card with stator and three-phase winding, run-up and operating capacitor and temperature sensor with constant current source
- 3 Rotors: squirrel-cage, permanent-magnet, rotor with open winding
- CD-ROM with Labsoft browser and course software

Course contents:

- Identifying the most common applications of rotating field machines
- Explanation of the principles of electromagnetic induction
- Explanation of the design and function of rotating field machines
- Explanation of the differences between motor and generator operation
- Introduction to the key components of a rotating field machine, the rotor and stator
- Experimental demonstration of how torque arises and of the generator principle
- Creation of a rotating magnetic field by rotating field machines: experimental demonstration of a rotating magnetic field in the stator
- Introduction to the principle of a 3-phase transformer
- Investigation by measurement of three-phase machines in star and delta configurations.
- Measurement of phase-to-phase and line-to-line voltage and current
- Measurement of rotor voltage and current
- Interpreting a rating plate
- Nominal data and characteristic parameters, power factor, pole-pairs, torque, speed and slip
- Design and function of asynchronous machines
- Investigation of a squirrel-cage rotor, frequency response characteristics, reversal of rotation
- Investigation by measurement of the operating response of a synchronous machine with a permanent magnet rotor
- Introduction to the principle of a capacitor motor (Steinmetz circuit)
- Investigation by measurement of the operating response of a capacitor motor

- Explanation of the importance of temperature monitoring in electrical machines
- Measurement of winding temperature in running machines
- Fault simulation (4 simulated faults activated by relay)
- Course duration. 5.5 h approx.

3 **Course - Electric Machines 3: Synchronous and slip-ring machines** SO4204-7U 1



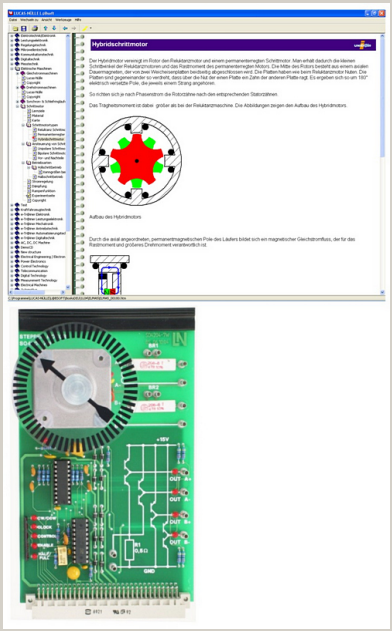
Includes:

- 1 Experiment card including stator with three-phase winding and starting resistors
- 3 Rotors: slip-ring rotor, synchronous rotor and reluctance rotor
- Stroboscope with extra-bright LED
- CD-ROM with Labsoft browser and course software

Course contents:

- Identifying the most common applications for synchronous rotors, slip-ring rotors and reluctance machines
- Explanation of a how a magnetic field arises in rotating field machines
- Explanation of the design and function of synchronous, slip-ring and reluctance machines
- Introduction to the key components of synchronous, slip-ring and reluctance machines (including salient pole, non-salient pole and reluctance rotors)
- Introduction to circuit diagrams, terminal charts and nominal data for synchronous, slip-ring and reluctance machines
- Interpreting a rating plate
- Introduction to the principles of speed control of slip-ring rotor machines
- Experimental investigation of the operating response of slip-ring rotor machines. Measurement of rotor voltages with open and shorted rotor windings, response to starting resistors, determining slip and speed by means of voltage measurements
- Explanation of the differences between motor and generator operation of synchronous machines
- Introduction to the principles of speed control of synchronous machines
- Experimental investigation of the operating response of synchronous machines: run-up behaviour, speed measurement, power factor determination (cos j) with the aid of current and voltage measurements
- Experimental investigation of the operating response of reluctance machines: creation of torque, run-up response, asynchronous and synchronous operation, reversal of rotation, power factor determination (cos j) with the aid of current and voltage measurements
- Course duration 5 h approx.

4 **Course - Electric Machines 5: Stepper motors** SO4204-7W 1



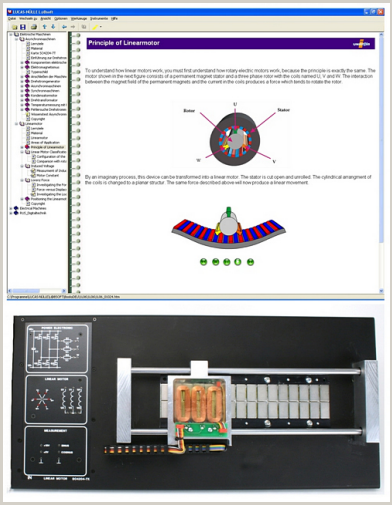
Includes:

- Experiment card with 2-phase stepper motor, 200 steps per revolution and Incremental disc
- Driver circuit with 6 control inputs and power amplifier, integrated current regulation, optional switching to resistor current limiting
- Overload and status display via LEDs
- CD-Rom with Labsoft browser and course software

Course contents:

- Introduction to customary applications of stepper motors
- Introduction to the design and function of stepper motors: Permanent-magnet stepper motors, reluctance and hybrid stepper motors
- Identifying the advantages and disadvantages of various stepper motors
- Introduction to the various principles for controlling stepper motors (unipolar und bipolar)
- Introduction to full-step and half-step operating modes
- Experimental determination of step angle, maximum operating frequency and maximum start frequency
- Investigation by measurement of control signals in half-step and full-step mode
- Analysis of control signals when rotation is reversed
- Introduction to various methods of current regulation for stepper motors
- Experimental determination of the current regulation in use on the basis of control signals
- Writing a program for positioning the stepper motor using relative or absolute positioning
- Course duration: 3.5 h approx.

5 **Course - Electric Machines 6: Linear motors** SO4204-7X 1



Includes

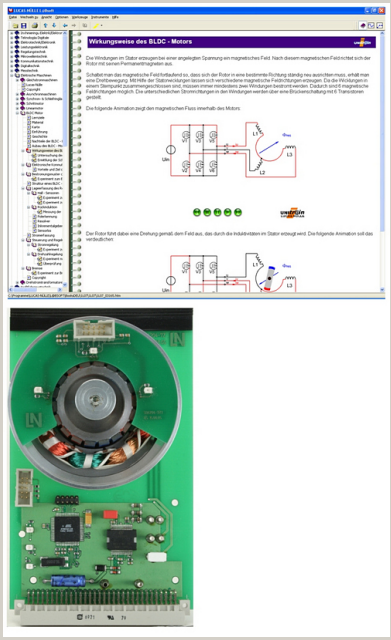
Experiment board with:

- Transparent linear motor with non-ferrous armature
- Range 340mm approx.
- Integrated microprocessor control
- 35W power amplifier
- Visualisation of control vector
- Position detection with analog Hall sensors
- CD-ROM with Labsoft browser and course software

Course contents

- Introduction to design and operating principle of a linear motor
- Explanation of terms "Lorentz force" and "induced voltage"
- Introduction to linear motor applications
- Designs of linear motors
- Advantages and disadvantages of linear motors in comparison to rotary motors
- Determination of characteristic values for a motor
- Positioning of a linear motor
- Determining motor position with the help of encoders or Hall sensors
- Distinction between relative and absolute positioning
- Determination of motor position using analog Hall sensors
- Course duration: 4.5 h approx.

6 **Course - Electric Machines 7: BLDC/servo motors** SO4204-7Z 1



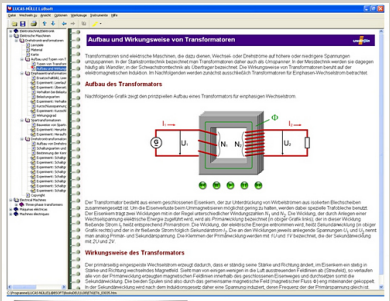
Includes:

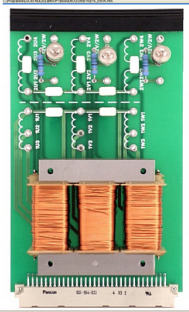
- 1 Experiment card featuring a brushless DC (BLDC) motor with electronic commutation, speed and torque control plus Hall sensors for measuring speed
- CD-ROM with LabSoft browser and course software

Course contents:

- Introduction to common applications of BLDC motors
- Introduction to design and function of BLDC motors
- Experimental investigation of how BLDC motors work
- Advantages and disadvantages of BLDC motors
- Introduction to various ciruits for controlling BLDC motors: square and sine-wave current signals
- Measurement and analysis of circuits
- Introduction to various methods of detecting rotor position: Hall sensors, back-emf, pole detection, resolvers and incremental sensors
- Measurement of position using Hall sensors
- Introduction to current and speed control of BLDC motors
- Experimental investigation of speed control
- Setting parameters for speed control
- Course duration: 5 h approx.

7	**Course - Single- and Three-phase transformers**	SO4204-7Y	1





Includes:

- 1 Experiment card with three-phase transformer, with 12 windings and tapings for study of single phase and three phase transformers and transformer circuits, three-phase load, useable for star and delta connection
- CD-ROM with Labsoft and course

Course contents:

- Principles of transformers
- Study of load characteristics of single phase transformers, for one quadrant and four quadrant operation
- Measurement of current and voltage under load / no-load conditions
- Study of the transformation ratio
- Equivalent circuit diagram
- Study of three-phase transformers
- Study of various three-phase transformer circuits and their effects on load / no-load operation
- Study of various circuits with unbalanced load
- Determination of short circuit voltage
- Duration approx. 3 h

Additionally recommended

Pos.	Product name	Bestell-Nr.	Anz.
8	**Stroboskop für UniTrain**	CO4203-2G	1

Stroboscope with ultra-bright LED for contactless measurement of rotational speeds. Adjustment of the flash frequency is performed using a virtual included in the courses Electrical Machines 1-3.

- Adjustable brightness for LED
- 0.5 m (approx.) connection lead with BNC socket
- Flash frequency 1-150 Hz

Additionally recommended

Pos.	Product name	Bestell-Nr.	Anz.
9	**UniTrain storage case for experiment board** 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	SO4203-2V	1