



FUNDAMENTALS
OF RAILWAY
TECHNOLOGY

LUCAS-NÜLLE FOR RAILWAY TECHNOLOGY

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Railway Application Technology

Railway lines are the most important transport lines in the development and supply of wide areas in countries of the world. More than 25% of freight transport and more than 75% of local public transport are performed by rolling stock and rail. Climate change and the ever-increasing volume of goods traffic will lead to rail becoming even more important in the coming decades. To limit global warming, among other things, a massive shift of traffic and transportation away from the roads to climate-friendly railways is necessary. In urban areas, the situation in passenger transport will also be impaired unless there is a shift to rail.

This makes it all the more important for our planners and engineers to undergo systematic and up-to-date education in technology and to gain an understanding of the relationships in the infrastructure and their forward-looking planning and maintenance.

Lucas-Nülle training systems support you in the technical basics and the interrelationships of various technologies, from electric and diesel-hydraulic drives, electrical mains and energy power supply up to rail-vehicle technology and signal control.



More Than Just a Training System

Blended Learning, including E-learning and Hands-On Training.

Lucas-Nülle is a highly respected developer and supplier of training systems, with a focus on providing not only a sound theoretical background but also the practical, hands-on skills that are essential to modern industry.

Using state-of-the-art technology, Lucas-Nülle has designed numerous training platforms and systems that include blended learning, e-learning and hands-on systems so that every facet of railway engineering can be modelled and explored individually and discretely.

The systems are designed to reflect as closely as possible the equipment and methods used in practice by industry itself. This means that when the trainees qualify, they will already possess the practical skills that they will need as they take the next step in their careers.



good
reasons
for Lucas-Nülle



Solution for Imparting the Basics of Railway Technology

Lucas-Nülle's range of training aids covers the basic skills required by the next generation of railway engineers and technicians.

Skills covered by Lucas-Nülle training systems for railway application:

- Electrical Engineering
- Drive Technology
- Electrical Control
- Automation
- Process Control & Sensorics
- Microcontroller
- Electrical Power
- HVAC / Air Conditioning
- Fluid Power / Hydraulics and Pneumatics
- Mechanical Systems
- Diesel Engines

 made
 in
 Germany

Let's get practical

EXPERIMENT. LEARN. UNDERSTAND.

Theory is only properly understood when applied in practice. This is why we take a hands-on learning approach. The degree of practical implementation increases depending on the system. This creates a positive teaching experience and allows students to engage in the learning process.

Basic Training



Modular Training Systems





Real-life application

Interactive software

ALL DIGITAL LEARNING CONTENT IS BASED ON OUR WELL-PLANNED TEACHING METHOD.

More than just hardware: interactive software is an essential part of all our systems. The digital courses contain animations, virtual instruments and experiments – which motivate learning with hands-on activities and procedures.

More Than Just a Training System

Fluid Power – Hydraulics and Pneumatics Training

Presenting complex training content in a vivid way using modern training media

Complete solutions for process control systems: PLC, AS-i, PROFIBUS, PROFINET, HMI, remote maintenance, safety technology, drive technology with the Industrial Conveyor Belt Systems

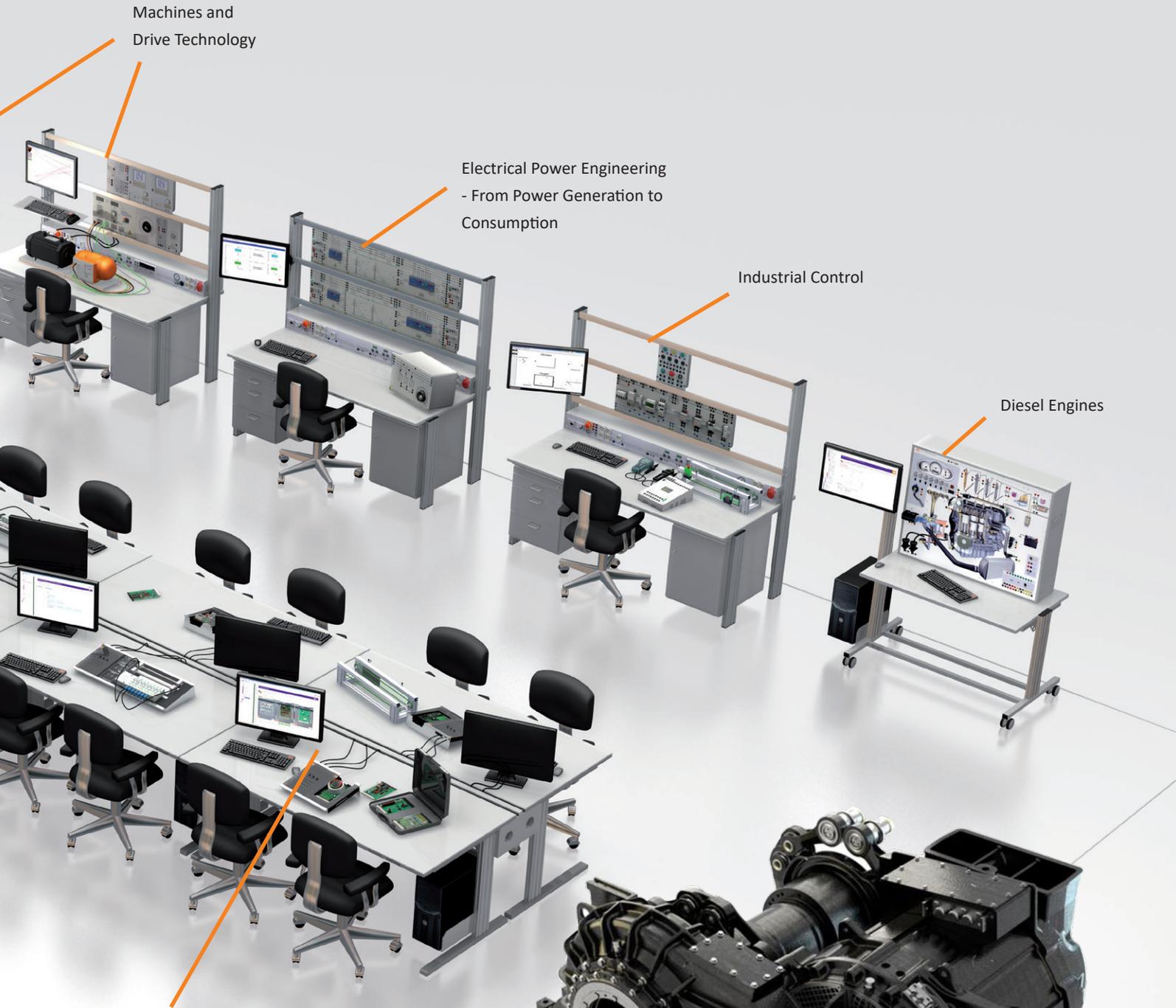
Machinery and Systems Engineering

Machines and Drive Technology

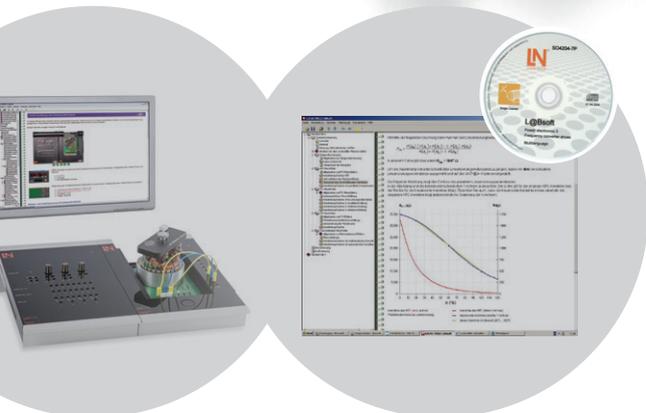
Electrical Power Engineering
- From Power Generation to Consumption

Industrial Control

Diesel Engines



With UniTrain, develop know-how and skills using multimedia



Real-life application
Authentic training in a safe environment



Convince yourself of the advantages:



Fundamentals of Electrical Engineering

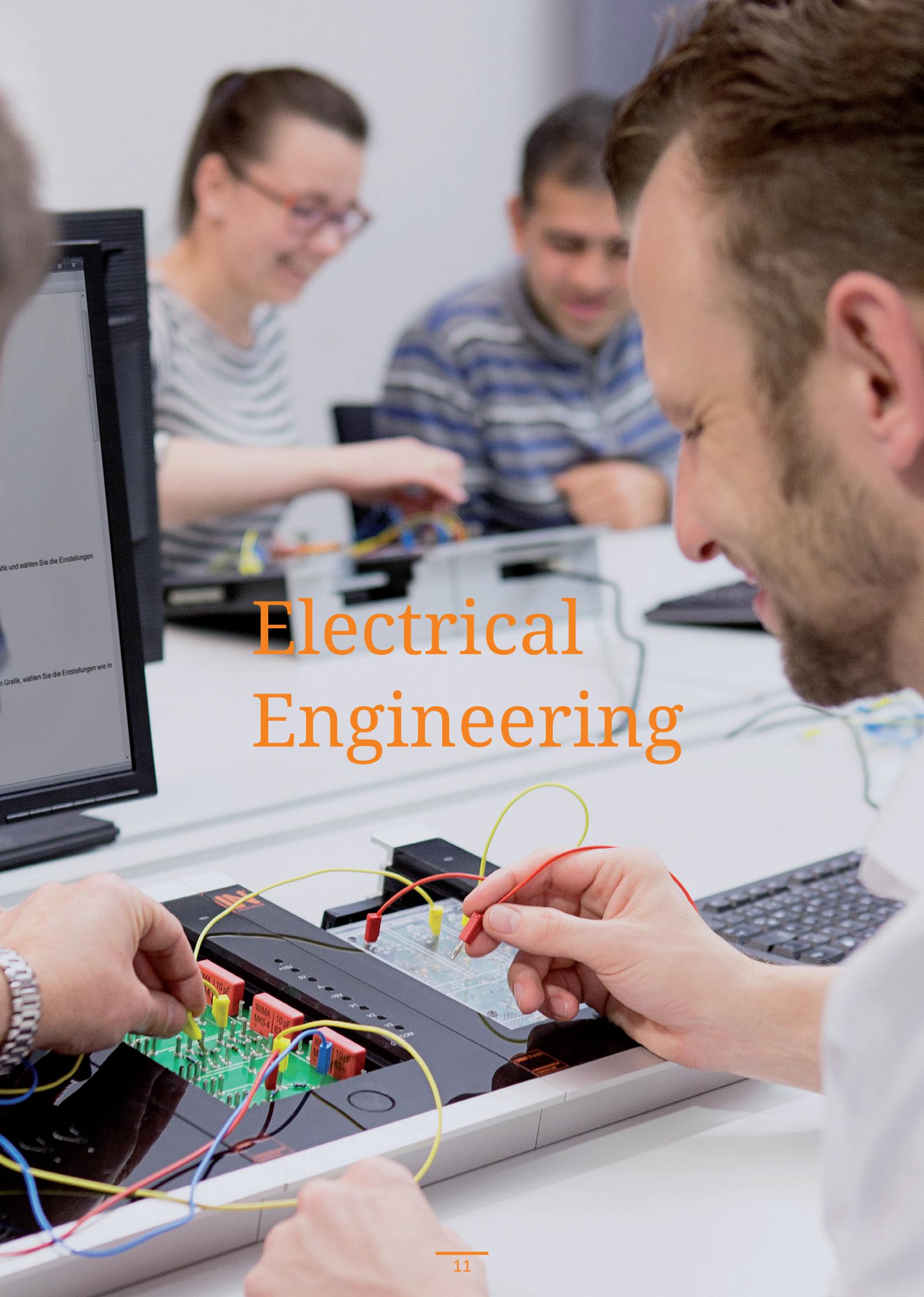
As in most industries today, modern railway vehicles involve a large amount of electrical equipment. Lucas-Nülle's UniTrain/Labsoft training systems, along with the Classroom Manager administration tools, help you to provide an introduction to the key components and principles of electrical engineering, including motors, generators and electronic components, as well as familiarising students with the use of circuit diagrams and essential measuring instruments.

UniTrain – Multimedia Desktop Lab

LEARNING – EXPERIMENTING – UNDERSTANDING

- More than 140 training programs
- Covers the entire field of electrical engineering
- More than 130 measuring instruments and power sources in a single system
- Promotes individual learning
- Practical skills gained by practical experimenting
- Safe experimenting with safety extra-low voltage
- Training programs combine theory and practice
- Authoring tools and administration

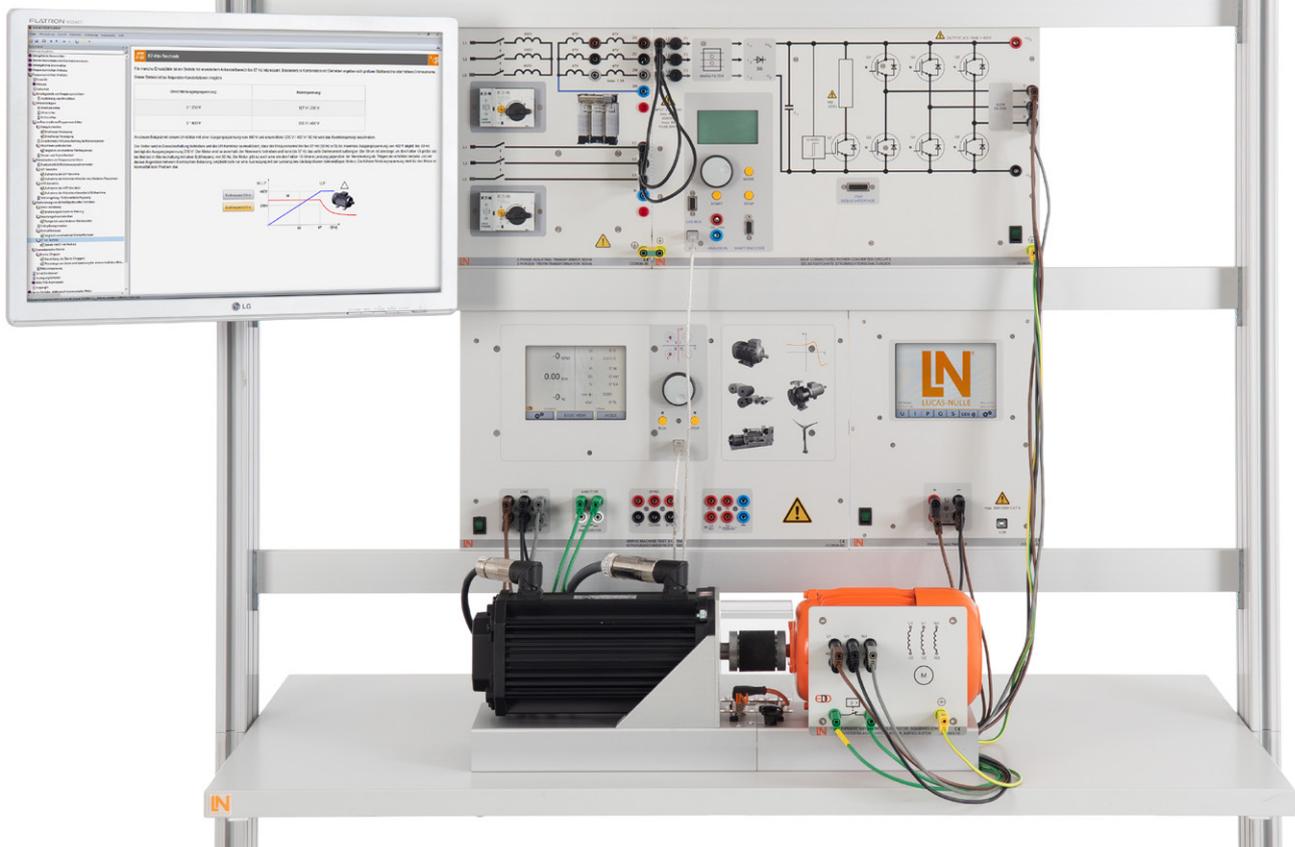
Benefits to you:

A photograph of a laboratory setting where several students are working on electronics projects. In the foreground, a man with a beard is focused on connecting wires to a breadboard. The breadboard contains a green PCB with various components, including red electrolytic capacitors labeled 'WIMA MKS4 60' and '10µF'. Other students in the background are also working at their desks, some looking at computer monitors. The overall atmosphere is one of collaborative learning and technical work.

Electrical Engineering

Drive Technology





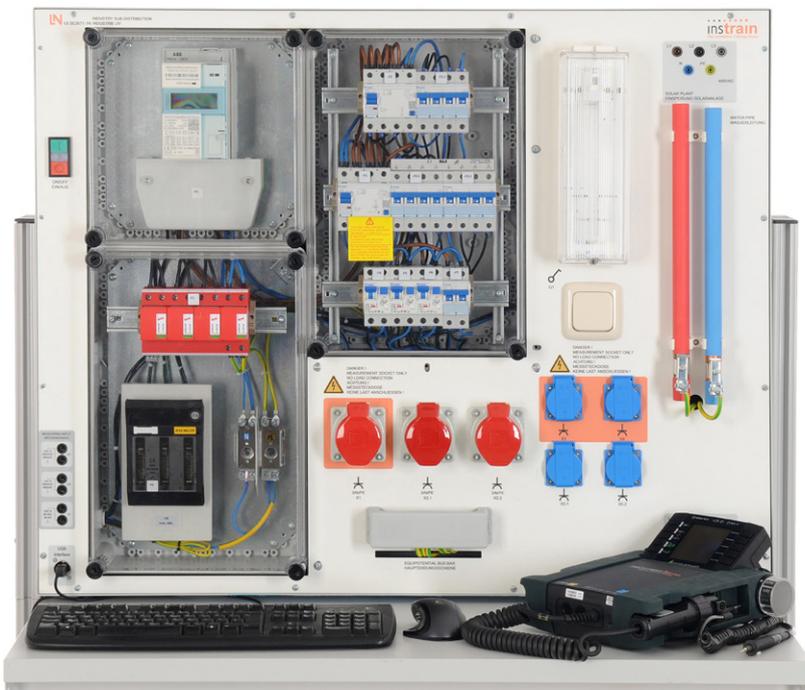
Electrical Machines and Drive Technology

The majority of modern trains these days are driven electrically or diesel-electrically, and even hydrogen-based concepts involve electrical drives. Many other services in railway vehicles also avail of electric motors. Maintenance personnel require not only an in-depth understanding of the various drives used, but must also master their control.

With Lucas-Nülle, you safely impart the necessary knowledge for working on these motors. By using practical exercises such as troubleshooting on common components, the systems help promote trainee expertise. The servo machine test system increases familiarity with actual practice by enabling trainees to replicate typical load scenarios in the laboratory.

- DC machines / AC machines
- Asynchronous machines
- Synchronous machines
- Frequency converter and servo amplifier drives
- Protection of electrical machines / Troubleshooting of machines
- Assembly of industrial control cabinets

Topic
coverage:



Industrial Control

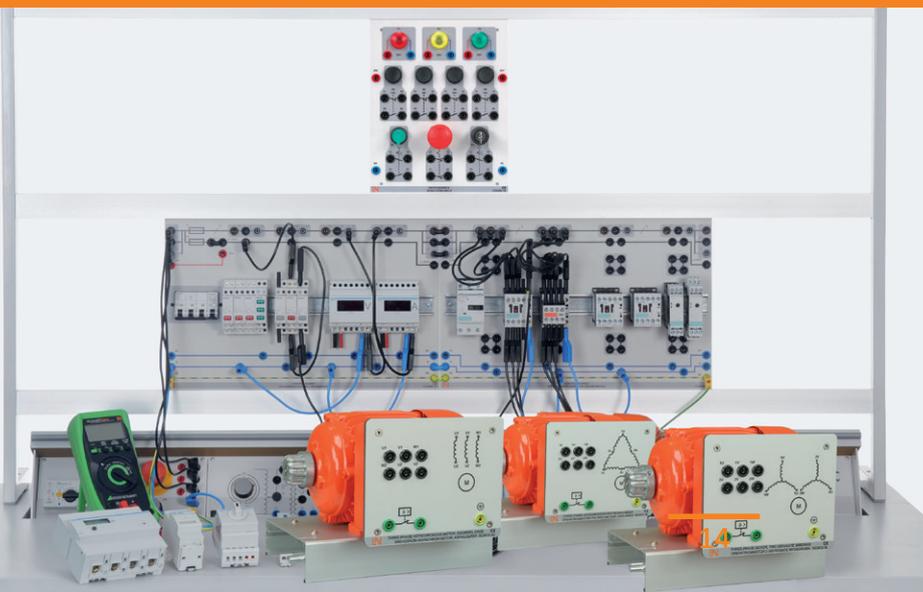
Industrial control systems are essential to any industrial installation. It is vital that such systems be both reliable and fail-safe. This topic ranges from simple control circuitry to modern PLC systems and their programming. Wiring of electrical systems is another inescapable necessity in the modern world. The training in protective measures that the systems impart includes both theoretical and practical instruction and provides ideal support for both.

INDUSTRIAL WIRING INSTALLATION

- Manual and contactor switching in three-phase circuits
- Complex plant circuitry
- Control and instrumentation project
- Plant measurement technology
- Programmable miniature control systems

PROTECTIVE MEASURES

- Standards and terms applicable to protective systems for electrical wiring
- Network earthing systems (for instance, TN, TT, IT)
- Protection against lightning and excess voltage
- Checking electrical appliances after maintenance
- Carrying out tests on built-in systems
- Systematic troubleshooting methods and developing fault-finding strategies

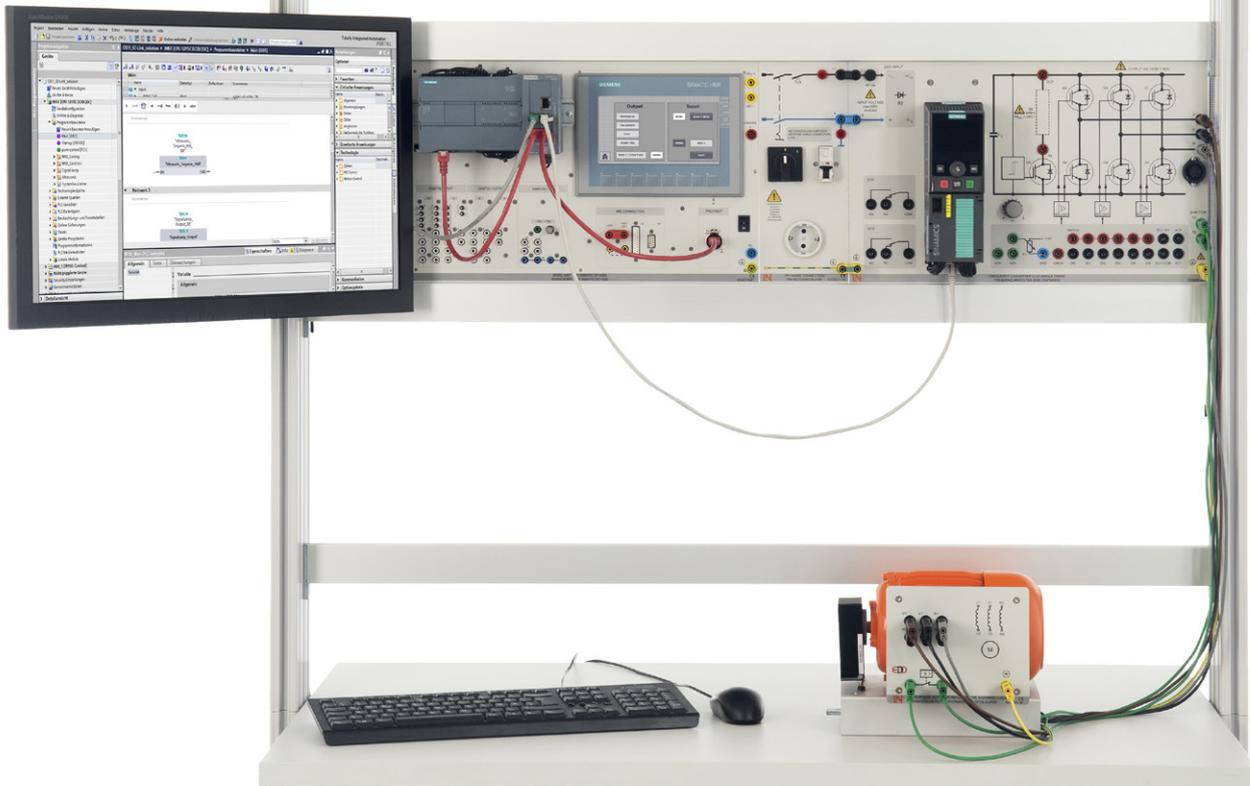




Electrical Control

Automation Technology





Automation Technology

A lot of operations nowadays are carried out by automated systems. Many such systems have programmable logic control (PLC) installations at their core. There is also a growing trend towards the interconnection of appliances and equipment by means of bus systems, which allow for extremely flexible automatic control. All of this demands that today's automation technicians should have been trained using practice-oriented training systems which teach them to understand the latest technology but also endow them with the required hands-on skills to use it.

- Human-machine interface (HMI)
- Bus communication systems
- CAN bus
- Drive technology
- Open-loop control
- Troubleshooting

Topic
coverage:

Telematic and Sensorics

In process control, all instruments and sensors within a system must be in permanent communication with each other, whereby both automated and manual systems are in place to manage individual systems as well as the entire flow of a process.

From closed-loop control of individual systems to flexible automation of entire processes, the various LN courses convey the fundamentals, the principles and the properties of telematics and sensor technology on components used in actual automated processing and production plant with the aid of animations and numerous videos. Multiple experiments cover investigation of controlled systems, determination of step responses and optimisation of control loops.

Topic coverage:

- Design, wiring and commissioning of a process engineering plant
- Selection, deployment and connection of different sensors and transducers
- Measurement of electrical and process-control variables like liquid level, flow-rate, pressure and temperature
- Design, assembly and commissioning of control loops
- Analysis of controlled systems and control loops
- Putting continuous and discontinuous controllers into operation
- Setting parameters and optimising P-action, PI-action and PID-action controllers
- Design of open-loop, closed-loop and PLC programs
- Operating and monitoring processes





Sensor Technology for Process Control

Abfahrt *Departure / Départ*

Zeit *Time/Temps*

Über *Via*

12:30 ICE 509 Lu. Wittenberg - Leipzig - Nürnberg

12:32 RE 3 Eberswalde - Angermünde

12:32 RE 3 B Südkreuz - Ludwigsfelde - Jüterbog

12:34 IC 144 Wolfsburg - Hannover - Amersfoort

12:37 RB 14 Berlin Zoo - B-Spandau - Brieselang

12:37 RE 2 B Friedrichstraße - B Alexanderplatz

12:38 ICE 802 B-Spandau - Hamburg Hbf

12:41 RE 1 B-Wannsee - Potsdam Hbf - Werder

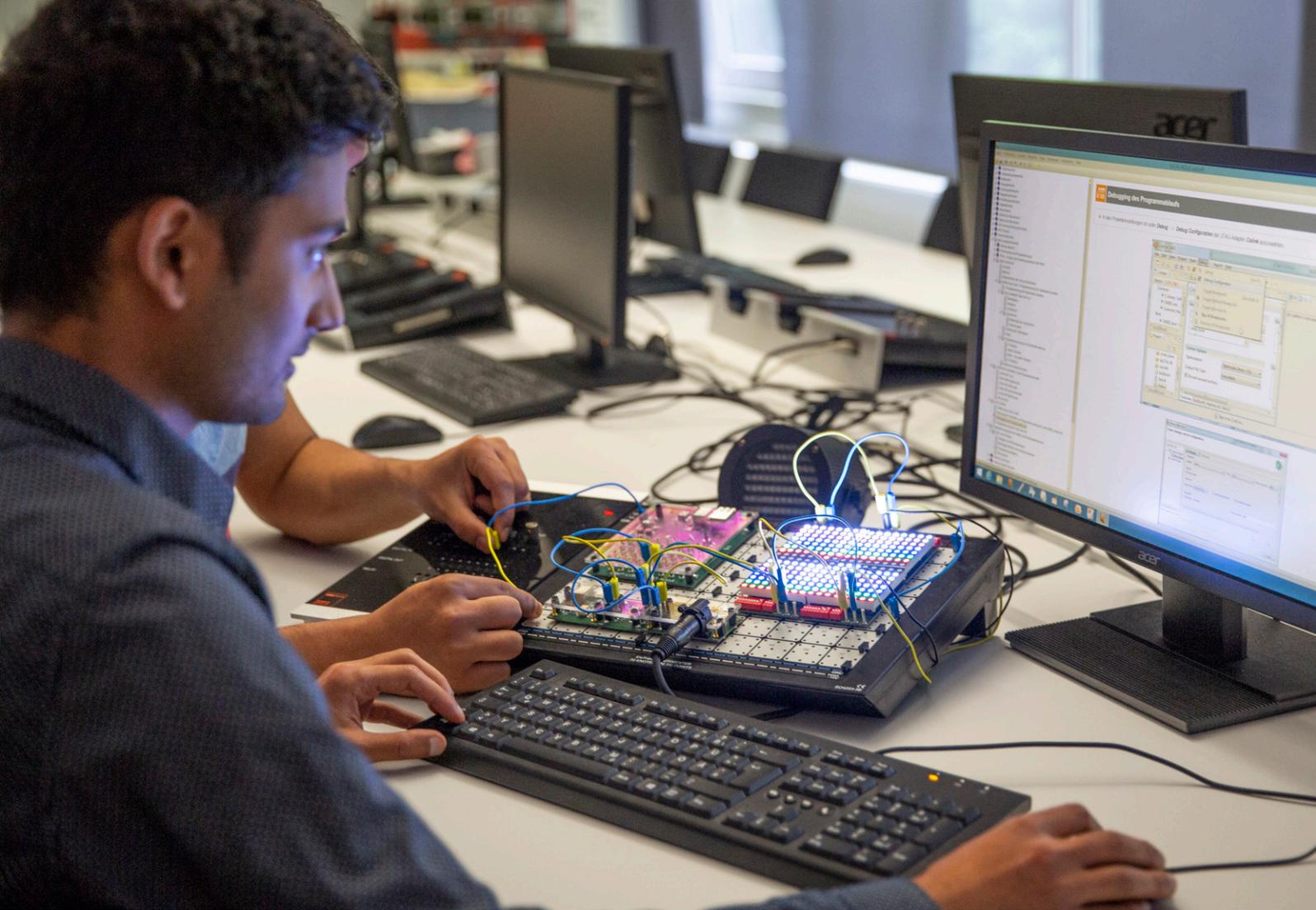
12:42 RE 5

12:43 RE 7 B Friedrichstraße - B Alexanderplatz

12:49 RE 1 B Potsdamer Pl.

12:50 ICE 5028 Hannover - Bochum - Düsseldorf ✈

Microcontrollers



Microcontrollers, FPGA, Microprocessors

Intelligent railway technology is based on cyber-physical systems. Nowadays, the necessary microcontrollers no longer exclusively operated by programmers. Using UniTrain, our complete package solution can teach various programming languages and hardware architectures in a common and easy-to-understand format.

Topic
coverage:

- Programming languages (including UML and VHDL)
- Hardware architecture from 8 bit to 32 bit
- Controlling cyber-physical systems (CPS)
- Programming the Internet of Things (IoT)
- Basics of computer technology



Electrical Power Engineering – From Power Generation to Consumption

The increasing electrification and automation of rail transport is leading to the growing significance of electrical energy in the industry. Lucas-Nülle systems from this area are being used at universities, training centres and schools all over the world. They provide the ideal basis for learning about the function and maintenance of electrical energy networks in a safe environment.

- Energy generation and consumption
- Energy transmission and distribution
- High-voltage transmission lines
- Energy management
- Protective systems training system
- SCADA control

Topic
coverage:

Electrical Power



HVAC | Air Conditioning



From basic to complex applications

Improved energy efficiency, new plant designs and refrigerants, complex regulations or customer-specific solutions: refrigeration and air-conditioning technology must also be constantly modernised in railway vehicles. Our systems explain the entire specialist area from basic thermodynamics to complex refrigeration applications in order to equip engineers and technicians with the knowledge they need.

Topic
coverage:

- Thermodynamics
- Refrigeration processes
- Industrial refrigeration technology
- Split-climate systems with heat pump function
- Assembly of refrigeration technology modules



Topic coverage:

- Pneumatics
- Electro-pneumatics
- Simple hydraulic systems
- Electro-hydraulics
- Mobile hydraulics
- Troubleshooting
- A multimedia course guides students step by step through the topics



Fluid Technology – Hydraulics and Pneumatics Training Equipment

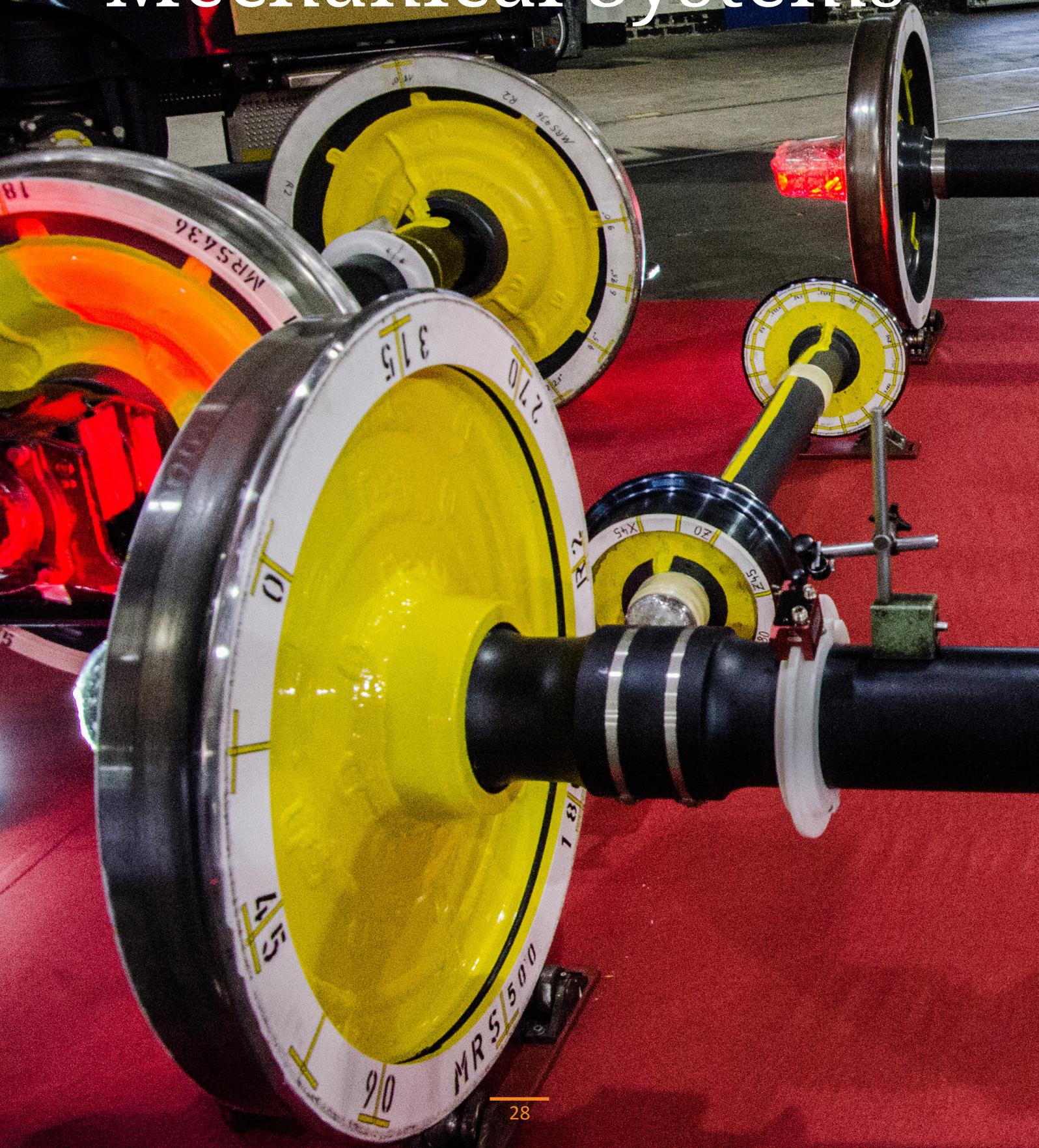
These training systems teach the skills needed to work with both pneumatic and hydraulic systems in railway engineering. Because they use components from leading manufacturers, these systems offer a very high level of practical relevance. The digital learning content guides trainees safely through the experiments while consolidating their theoretical understanding.



Fluid Technology Hydraulics | Pneumatics



Mechanical Systems

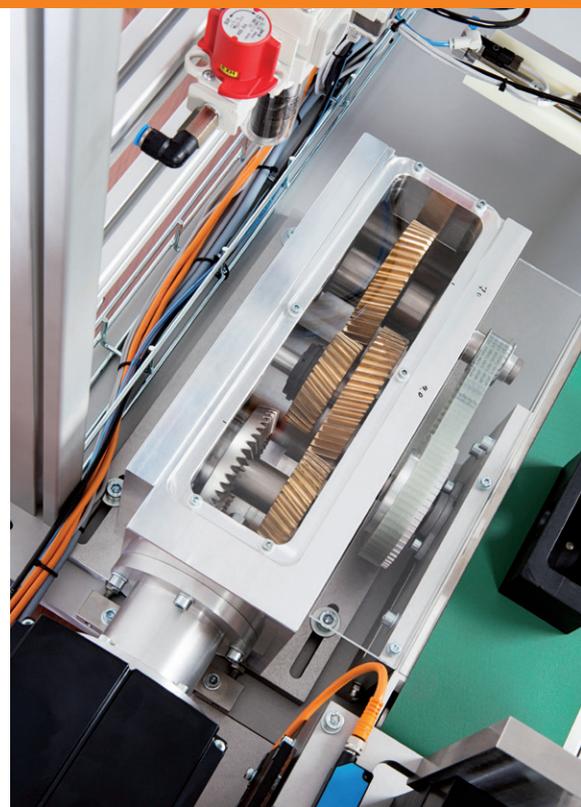


Machinery and Systems Engineering

Provide instruction on the installation, operation and maintenance of mechanical systems. Lucas-Nülle offers you numerous training systems from the field of mechanical and systems engineering, encompassing conveyor belt systems, chain drives, various types of gears and transmission as well as clutches and brakes. Thanks to the digital learning content, you can include the role of mechanical systems in the context of your education and training.

Topic
coverage:

- Assembly and disassembly of components
- Belt drives
- Chain drives
- Introduction to the functioning of gearbox transmissions
- Bearings
- Gaskets and seals
- Clutches and brakes
- Maintenance and repairs
- Commissioning and optimisation of configuration





Diesel Engines

The diesel engine is still a mainstay of rail transport and will remain so for the foreseeable future. With the 'Common Rail' training system, you teach the principles and function of diesel engines. The system is based on real components from actual practice. This enables learners to develop practical skills in the safe environment of the laboratory.

- How an engine management system works
- Design and function of sensors and actuators
- Enhancing diagnostic skills
- Making measurements on the components of an engine management system as done in practice
- Measurement and testing of electrical, electronic, mechanical and pneumatic variables
- Configuration of engine management systems
- Technical communication

Topic
coverage:

Diesel Engines



LUCAS-NÜLLE EXPERTISE:

- Supply of laboratory equipment and furniture
- Target oriented project design
- All-in-one services from concept to realization
- Turn-key solutions
- Competent partner in the field of technical education for over 40 years



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