COURSE AND EQUIPMENT OVERVIEW

Electrical fundamentals

- DC technology CO4204-4D (1)
- AC technology CO4204-4F (1)
- Three-phase technology CO4204-4H (1)
- Magnetism / electromagnetism CO4204-4A (1)
- Conducting measurements with the multimeter CO4204-4B (2)
- Electrical network analysis CO4204-4C (1)
- Electromagnetic compatibility (EMC) CO4204-4K (1)
- Measurements using an oscilloscope CO4204-4L (1)

ElotTrain 2-mm plug-in system

- DC technology CO4206-1A
- AC and three-phase technology CO4206-1B

Electronics

- Semiconductor components CO4204-5A (1)
- Transistor multivibrators CO4204-5D (1)
- Transistor and amplifier technology CO4204-5H (1)
- Field-effect transistors CO4204-5K (1)
- Operational amplifiers CO4204-5M (1)
- Power semiconductor devices CO4204-5P (1)
- Analog power supplies CO4204-5R (1)
- Switched-mode power supplies CO4204-5S (1)
- Circuit design using NI Multisim SO4204-5U (1)
- PCB layout with NI Ultiboard CO4204-5V

ElotTrain 2-mm plug-in system

- Semiconductors CO4206-1C
- Basic electronic circuits CO4206-1D
- Optoelectronics CO4206-1E

Digital electronics and microcomputer technology

- Gates and flip-flops CO4204-6A (1)
- Sequential circuits CO4204-6C (1)
- Application circuits CO4204-6E (1)
- Converter circuits CO4204-6B (1)
- Fundamentals of computer technology CO4204-6H (1)
- Supplement to CO4204-6H Applications and programming CO4204-6J (2)

ElotTrain 2-mm plug-in system

- Introduction to digital technology SO4206-1F
- Sequential circuits SO4206-1G
- Microcontroller PIC16F887 (Assembler programming) SO4206-9A
- 8 Bit Microcontroller PIC (UML programming) CO4205-7F
- Arduino UNO (UML programming) CO4205-7G
- Supplement to CO4205-7G Industrial interface CO4205-7W
- 16 Bit Microcontroller dsPIC (UML programming) CO4205-7C
- 32 Bit Microcontroller ARM (UML programming) CO4205-7D
- Programming 32 Bit ARM Cortex M3 microcontroller (C programming) SO4206-9B
- DSP using microcontroller 32-Bit ARM Cortex-M3 (C programming) SO4206-9C
- FPGA - Design of circuits using VHDL SO4206-9E
- FPGA Altera Cyclone IV (Verilog) CO4205-7E

Building management systems

- Protective measures and power network types CO4204-4M
- Control systems / protective circuitry CO4204-4N
- LED lighting and colour detection CO4204-4P (1)

Electrical power engineering

- Photovoltaics CO4204-3A
- Transient processes in DC and AC networks CO4204-3B (1)
- Fuel cell technology CO4204-3C

Power electronics

- Self-commutated power converters CO4204-7M (2)
- Line-commutated power converters, 3-phase CO4204-7N (2)
- Frequency converter drives CO4204-7P Requires CO4204-7M and CO4204-7T (3)
- Active power factor correction (PFC) CO4204-7Q (1)

Electrical machines

- DC machines CO4204-7R (1)
- Asynchronous machines CO4204-7T (1)
- Synchronous and slip-ring machines CO4204-7V (1)
- Stepper motor CO4204-7W (1)
- Linear motor CO4204-7X
- Three-phase transformer CO4204-7Y (1)
- BLDC / servo motors CO4204-7Z (1)

Communication technology

- Quadripoles and filters CO4204-9A (1)
- Active filters with operational amplifiers CO4204-9B (1)
- Coaxial cables SO4204-9G (1)
- Signal transmission via optical fibres 650 nm / 820 nm CO4205-4E (2)
- Signal transmission via optical fibres 1300 nm CO4205-4F (1)
- 4-wire lines SO4204-9F (1)
- Pulse modulation methods PAM / PCM / Delta CO4204-9J (3)
- Pulse modulation methods, PTM CO4204-9K (1)
- Modem methods ASK, FSK, PSK CO4204-9L (2)
- AM / FM modulation / demodulation CO4204-9M (2)
- AM transmission and receiving technology CO4204-9N (3)
- Data acquisition using RFID & NFC CO4205-4S (2)
- Network technology and cybersecurity CO4205-4Q (2)
- Introduction to microwave technology SO4204-9U (1)
- Supplement to SO4204-9U Waveguide components SO4204-9V
- Antenna technology SO4204-9T (1)
- Supplement to SO4204-9T Complex antenna systems SO4204-9Z
- Microstrip technology CO4204-9Y (1)

Measurement technology

- Measurement of electric values V / I / P / cos-phi / f CO4204-8A (2)
- Measurement of non-electric values temp. / pressure / force CO4204-8B (2)
- Measurement of non-electric values displacement / angle / speed CO4204-8C (2)
- RLC measurements CO4204-8D (2)

Automatic control technology

- Practical introduction to control technology CO4204-8J
- Servo motor technology CO4204-8H

Automation

- Fundamentals of PLC technology CO4204-8M
- PLC model lift application CO4204-8T (1)
- Sensors for automation CO4204-8U
- Basics robot technology CO4204-3Q

Pneumatics / hydraulics

- Pneumatics CO4205-5E
- Electropneumatics CO4205-5F
- Hydraulics / electrohydraulics CO4205-8A

Automotive technology

- DC and AC circuits in vehicles CO4204-7A (1)
- Electronics and digital technology in vehicles SO4204-7B (1)
- Automotive electrical fundamentals CO4205-1G
- PWM signals in automotive engineering CO4204-7J (1)
- Alternator / 3-phase generator CO4204-7D (2)
- Sensors in motor vehicles CO4204-7F
- Pulse generation and ignition systems CO4204-7C
- Common rail diesel injection system CO4204-6X
- Traction control systems ABS / ASR / ESP CO4204-6W
- Wheel speed sensor technology CO4205-1F
- Airbag, belt tensioners and crash response CO4204-6Z (2)

ElotTrain 2-mm plug-in system

- Fundamentals of electrical engineering in vehicles SO4206-1J

Automotive technology

- LIN bus CO4204-7E (2)
- CAN bus CO4204-7K (2)
- CAN FD in automobiles CO4205-1S
- Ethernet in motor vehicles CO4205-1A (3)
- 48V sub-systems in on-board vehicle networks CO4205-1T
- Optical data buses for automotive applications CO4204-7H (1)
- FlexRay CO4204-6Y
- Comfort systems and keyless entry CO4204-6G (1) (3)*
- Autoshop communications and RFID CO4205-1N (2)
- DC-AC conversion in vehicles CO4204-6L (1)
- Hybrid drives in automobiles CO4204-6V (3)
- Interlock in hybrid and electric vehicles CO4205-1H (1)
- Battery disconnect unit in hybrid and electric vehicles CO4205-1J (1)
- DC-DC step-up converters in hybrid and electric vehicles CO4205-1K (1)
- DC-DC step-down converters in hybrid and electric vehicles CO4205-1L (1)
- Safe handling of HV systems CO4205-1M (1)
- Fuel cell technology in vehicles CO4204-6M
- Solar technology in vehicles CO4205-1P

* 3 experimenters are required for extension with CAN bus course (CO4204-7K)

Automotive technology

- Lidar system in motor vehicles CO4205-1E (1)
- Gesture control and capacitive touchscreen in the motor vehicle CO4205-1U (1)
- Rear view camera with park assist CO4205-1C (1)
- Traffic sign recognition with speed control CO4205-1B (1)
- ACC with Emergency Brake Assist CO4205-1V (1)

Basic equipment and accessories

Basic equipment

- UniTrain interface CO4203-2A
- UniTrain measurement accessories (shunts, jumpers and connection cables) CO4204-2J

Required accessories

Depending on the course one or more UniTrain experimenters are required.

- (1) UniTrain experimenter (quantity) CO4203-2B

Basic equipment EloTrain 2-mm plug-in system

- UniTrain interface CO4203-2A
- EloTrain experimenter CO4203-3B
- EloTrain measurement accessories (bridge connectors and connection cables) SO5146-1N
- Digital multimeter Max 10 LM2332

Recommended accessories

- UniTrain storage case CO4203-2Y
- Digital multimeter Multi 13S LM2330

LabSoft Classroom Manager

- LabSoft Classroom Manager SO2001-5A
- Collections of assignments (for use with Classroom Manager)
- Electrical fundamentals SO2001-6A
- Elektronics SO2001-6B
- Digital electronics SO2001-6C
- Electrical power engineering SO2001-6D
- Building management systems SO2001-6E
- Automotive technology SO2001-6F

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