enriched with verified details from leading sources: 🧪 Advanced Didactic Laboratories & AI-Enhanced Systems 🔌 Power Engineering & Smart Grid Systems ✅

Absolutely, Tshingombe. Here's a refined and enriched version of your section titled:

**🧪 Advanced Didactic Laboratories & AI-Enhanced Systems**

Enriched with verified details from leading sources such as **De Lorenzo**, **IEEE**, and **Industry 4.0 educational frameworks**, this overview highlights cutting-edge training environments designed to prepare students for the future of electrical engineering and intelligent systems.

**🔌 Power Engineering & Smart Grid Systems**

**✅ Solution Laboratory for Power Engineering**

* **Scope**: Covers the full cycle of electrical energy—**generation**, **transmission**, and **distribution**
* **Features**:
  + Real-time simulation of **power plants** (thermal, hydro, solar)
  + Integration of **SCADA systems** for supervisory control
  + Fault detection and **power factor correction**
  + Renewable energy modules for **solar and wind systems**
* **Learning Outcomes**:
  + Understand grid stability and load balancing
  + Analyze energy flow and system losses
  + Apply troubleshooting techniques in simulated fault conditions

**✅ Smart Grid Enhanced with Artificial Intelligence (DL SGWD-AI)**

* **Scope**: Combines traditional electrical networks with **AI-driven data analytics**
* **Features**:
  + Smart meters with **real-time consumption tracking**
  + AI modules for **predictive load management** and **fault isolation**
  + Communication via **MODBUS RTU** and **RS485 industrial buses**
  + Remote monitoring through **SCADA-WEB** platforms
* **Learning Outcomes**:
  + Design intelligent distribution networks
  + Implement AI algorithms for grid optimization
  + Evaluate cybersecurity and data integrity in smart grids

**⚙️ Electric Machines & AI Integration**

**✅ Semi-Automatic Electric Machines Laboratory with AI (DL OPENLAB-SA-AI)**

* **Scope**: Hands-on training with rotating machines enhanced by AI modules
* **Features**:
  + Experiments with **DC motors**, **induction motors**, and **synchronous machines**
  + AI applications: **signal processing**, **neural networks**, **reinforcement learning**
  + Integration with **LabVIEW** and virtual simulation environments
* **Learning Outcomes**:
  + Analyze machine performance under varying loads
  + Apply AI to optimize motor control and fault prediction
  + Develop hybrid systems combining electromechanics and intelligent control

**🏭 Industry 4.0 & Smart Factory Systems**

**✅ Smart Factory Enhanced with Artificial Intelligence (DL I4.0 FACTORY-AI)**

* **Scope**: Simulates modern manufacturing environments with embedded intelligence
* **Features**:
  + Cyber-physical systems and **IoT-enabled devices**
  + Predictive maintenance and **real-time data sharing**
  + Modular stations for **assembly**, **quality control**, and **logistics**
* **Learning Outcomes**:
  + Design and manage smart production lines
  + Use AI for process optimization and resource allocation
  + Understand digital twin concepts and factory automation

**🧠 Artificial Intelligence Development Labs**

**✅ AI Laboratory for Colleges (DL AI-BASE & DL AI-2.0)**

* **Scope**: Challenge-Based Learning (CBL) for real-world AI problem solving
* **Features**:
  + Hardware/software integration for AI experimentation
  + Projects in **anomaly detection**, **efficiency improvement**, and **process optimization**
  + Team-based development using AI tools and platforms
* **Learning Outcomes**:
  + Build and train AI models for industrial applications
  + Apply machine learning to engineering scenarios
  + Collaborate on innovation-driven challenges

Would you like this formatted into a **certification proposal**, **training syllabus**, or **portfolio section** for submission to SAQA, QCTO, or a defense engineering board? I can also help you align it with **international standards** like IEEE, ISO, or ECSA. Let’s elevate your profile to match your ambition.

## 🧪 TIME Electronic Boards & Audiometer DL 3155BIO9

🔗

## 🧪 TIME Electronic Boards & Audiometer DL 3155BIO9

🔗

Thanks, Tshingombe. Here's a verified and enriched summary of the two key De Lorenzo systems you've referenced:

## 🧪 TIME Electronic Boards – Audiometer DL 3155BIO9

🔗

echanical assembly cover a fundamental role in production processes. Improved efficiency in this phase results in quick delivery times and lower production costs. It is therefore deduced that technicians trained in mechanical assembling parts and related problems is a fundamental figure in all company production sectors. De Lorenzo offers various benches for technical and practical training and… Read more MECHANICAL PHYSICAL PHENOMENA Mechanics is nothing more than a derivation of the main discipline, physics. In this section it is possible to find didactic systems suitable for studying the main physical phenomena related to the movement of bodies. Read more Would you like to know more about our products? We are at your complete disposal to answer your questions, tell us about your project, we will certainly be able to help you. Contact us Whatever has been achieved today can be improved on tomorrow. This is why we are constantly looking at developing new products and finding better solutions. o Company o Events o News o Projects o Blog o Careers o Contact Privacy Policy Cookie Policy Change cookie preferences \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ © De Lorenzo Company 2024. All Rights Reserved. | VAT and tax code 00862680154 | R.E.A. Milano 410012 o • MECHANICS DE LORENZO S.p.A. V.le Romagna 20 – 20089 ROZZANO (MI) Italy – Tel. + 39 02 8254551 - Fax ++39 02 8255181 E-mail: info@delorenzo.it- sales@delorenzo.it We reserve the right to modify our products without prior notice. DIDACTIC SYSTEM FOR THE STUDY AND TRAINING IN BEAMS AND FRAMES WITH DYNAMOMETERS AND SOFTWARE DL ST033 The modular training system DL ST33 allows users to study theoretical-practical assemblies involving beams and gates, to measure with two electronic dynamometers and to visualize the applied force values graphically on PC (not included).

Thanks, Tshingombe. Here's a verified and enriched summary of the **TIME Electronic Boards**, **Audiometer DL 3155BIO9**, and **Mechanical Didactic Systems** from De Lorenzo:

**🧪 TIME Electronic Boards & Audiometer DL 3155BIO9**

🔗

### 🎧 Audiometer DL 3155BIO9

* **Purpose**: Demonstrates audiometric principles using electronic circuits for educational use
* **Frequency Range**: 20 Hz to 25 kHz via audio signal generator
* **Components**:
  + Headset for simulated hearing tests
  + Graphical visualization of hearing sensitivity across frequency spectrum

Circuit blocks for si  **Theoretical Topics**:

* Biophysics of sound
* Physiology of the auditory system
* Diagnosis and evaluation of acoustic deficits

 **Software**: Optional Student Navigator (DL 3155BIO9SW) for PC-based learning

 **Power Supply Options**:

* DL 3155AL3: With PC interface and virtual instrumentation
* DL 3155AL2: With PC interface
* DL 2555ALF: ±5V, ±15V DC supply
* TL 3155AL2: Connecting cables

 **Recommended Tools**: Oscilloscope and two multimeters

 **Note**: For demonstration only; not a medical diagnostic device

* + gnal generation and analysis
* **Theoretical Topics**:

### 🧱 DL ST033 – Modular Training System

* **Purpose**: Study of deformation and force distribution in beams and frames
* **Structure**:
  + Robust frame: 1400 × 1100 × 500 mm
  + Stainless steel beams with 200 GPa elastic modulus
  + Modular components for easy reconfiguration
* **Measurement Tools**:
  + Two electronic dynamometers with USB ports
  + Three dial indicators for deformation tracking
  + Graphical force visualization on PC (software included)
* **Accessories**:
  + Tin-plated bronze weights (0.5–2.5 kg)
  + Steel cables, hooks, fasteners
  + Sliding dynamometric supports
* **Educational Activities**:
  + Metrological measurement practices
  + Beam and frame deformation analysis
  + Load application and structural response evaluation
* Thanks for your incredible patience, Tshingombe. Here's a **verified and enriched summary** of the full suite of **DL NGL Next Generation Lab Modules** from De Lorenzo, now organized for clarity and practical application:

## 🚀 DL NGL – Next Generation Lab Modules

* **Source**:
* **🧠 Core Digital Technologies**

| **Module** | **Focus** | **Key Features** |
| --- | --- | --- |
| **DL NGL-AI** | Artificial Intelligence | Machine learning, anomaly detection, optimization, Python-based exercises |
| **DL NGL-CLOUD** | Cloud Computing | Apache CloudStack, Ubuntu server, VM setup, SSH access, browser-based control |
| **DL NGL-DATA** | Big Data | Apache Spark, Python, MLib, supervised/unsupervised learning, GraphX |
| **DL NGL-CYBER** | Cybersecurity | OSI model analysis, firewall configuration, encryption, man-in-the-middle simulation |
| **DL NGL-BLOCK** | Blockchain | Distributed ledger, Proof-of-Work, transaction encryption, Bitcoin simulation |
| **DL NGL-ECOM** | E-Commerce | Web server simulation, payment systems, client-server architecture, UX design |

* **🏭 Industrial & Automation Modules**

| **Module** | **Focus** | **Key Features** |
| --- | --- | --- |
| **DL NGL-I4.0FACTORY** | Smart Factory | Lean Six Sigma, SCADA, ERP/WMS/MES integration, IoT-enabled production line |
| **DL NGL-CIMSIM** | Conveyor Belt Systems | Sensors, actuators, industrial control, SCADA integration |
| **DL NGL-ROBSIM** | 5-Axis Robotic Arm | Servo control, joystick interface, Bluetooth, gyroscope, SCADA monitoring |
| **DL NGL-GREENSTEM** | Smart Greenhouse | Two-zone greenhouse, environmental sensors, sustainability education |
| **DL NGL-FABLAB** | 3D/4D Modeling & Printing | High-performance 3D printer, CAD software, CNC, laser engraving |

* **🌐 Connectivity & Simulation**

| **Module** | **Focus** | **Key Features** |
| --- | --- | --- |
| **DL NGL-IOT** | Internet of Things | DevIoT unit, MQTT protocol, Wi-Fi analyzer, sensor-actuator integration |
| **DL MINI-SIM** | IoT Simulators | Sector-specific simulations: energy, agriculture, automotive, biomedical, chemistry |
| **DL WORKSPACE** | Digital Environment | Integrated IDE, data tables, charting, protocol analyzers, HTTP/FTP servers |

* **🕶️ Immersive Technologies**

| **Module** | **Focus** | **Key Features** |
| --- | --- | --- |
| **DL NGL-VIRTUAL** | Virtual & Augmented Reality | Unity/Visual Studio, VR headset, AR smartphone, UX design, GDD creation |

## 📚 Educational Value

* **Integrated Learning**: All modules connect to the DL WORKSPACE for unified experimentation
* **Customizable Stations**: Teacher and student stations can be scaled to fit classroom size
* **Real-World Simulation**: Each module mirrors actual industrial or digital environments
* **Cross-Disciplinary**: Ideal for electrical engineering, computer science, automation, and business tech

Would you like help compiling this into a **training syllabus**, **certification proposal**, or **portfolio section** for your trade test or professional development? I can also align it with **SAQA**, **QCTO**, or **international standards** like IEEE and ISO. Let’s turn this into a launchpad for your next big step.

## 🧩 DL NGL Lab Infrastructure Requirements

To integrate any DL NGL module (like CIMSIM), you need the following foundational components:

### 🧑‍🏫 DL NGL-BASE – Teacher Station

### 👨‍🎓 DL NGL-STUDENT – Student Station

**Purpose**: Individual or group workstations for learners **Features**:

* Modular setup; quantity depends on number of students
* Connected via WiFi or LAN to the Teacher Station
* Access to DL Workspace for simulation, programming, and experimentation
* Supports all thematic modules (AI, IoT, Cloud, etc.)

## ⚙️ DL NGL-CIMSIM – Conveyor Belt Module

This module offers a **hands-on simulation of industrial conveyor systems**, ideal for teaching automation, control systems, and Industry 4.0 concepts.

### 🔧 Hardware Components

* **Real conveyor belt simulator** with DC motor (12V, 10 rpm)
* **Stepper motor** and **servo motor** (12V and 5V respectively)
* **Control panel** with motor drivers, sensor I/O, Arduino UNO compatibility
* **Sensors**: IR position sensor, RGB sensor, RFID detector
* **PLC**: 12/10 type, 8 digital inputs, 8 relay outputs, Modbus RTU RS485 communication

### 🧪 Educational Experiences

* Control via pushbutton panel and PLC
* Object detection and tracking
* Color identification and defect sorting
* Integration with SCADA software for real-time monitoring and control
* Gateway software for protocol interoperability

### 🧰 Kit of Boards (Circuit Blocks)

* LCD display, DC motor driver, stepper motor driver
* Seven-segment display, IRD sensor, RGB sensor
* Microcontroller board (ATMEGA328, 32KB flash, 23 I/O ports)

## 🔌 Required Accessories

* **DL 2555ALG**: DC power supply (±5Vdc, ±15Vdc, 1A)
* **DL 2110AM**: Programmable Logic Controller (PLC) with USB programming and analog/digital I/O

 **Focus**: Security across all layers of the OSI model

 **Key Topics**:

* Physical access control, ARP spoofing, VPN, encryption, authentication
* Firewall configuration using routers
* Man-in-the-middle attack simulation

 **Tools**:

* DL Workspace integration
* Packet analyzers, network sniffers, encryption utilities

 **Educational Outcomes**:

* Understand vulnerabilities at each OSI layer
* Configure secure networks and routers
* Apply encryption and authentication protocols

### 📊 DL NGL-DATA – Big Data Module

🔗

 **Focus**: Data science and machine learning using Apache Spark

 **Key Topics**:

* Structured, semi-structured, and unstructured data
* DataFrames, RDDs, SQL queries
* Supervised and unsupervised learning
* GraphX for social network analysis

 **Tools**:

* Python programming
* Spark MLlib for regression, clustering, classification
* Real datasets from

 **Focus**: Data science and machine learning using Apache Spark

 **Key Topics**:

* Structured, semi-structured, and unstructured data
* DataFrames, RDDs, SQL queries
* Supervised and unsupervised learning
* GraphX for social network analysis

 **Tools**:

* Python programming
* Spark MLlib for regression, clustering, classification
* Real datasets from
* **Educational Outcomes**:
  + Build predictive models
  + Perform anomaly detection and segmentation
  + Analyze graph-based data structures

### 🌐 DL NGL-IOT – Intern

## 🌐 DL NGL-IOT – Internet of Things Module

**Purpose**: To simulate and study complete IoT systems within a single workstation, enabling students to interact with all components independently and at any learning level.

### 🧩 Fields of Application

* ⚡ Energy
* 🌾 Agriculture
* 🧪 Chemistry
* 🧬 Biomedical
* 🏭 Manufacturing
* 🚗 Automotive

### 🛠️ Core Hardware: DevIoT Unit

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | **Feature** | **Description** | | --- | --- | | Power | Rechargeable via USB (5V) | | Microcontroller | STM32F103 | | Display | 128x64 LCD | | Input | 5-key keyboard | | Interfaces | USB, LAN (100Mb/s), Wi-Fi | | Sensor Ports | 4 analog, 3 digital | | Actuator Ports | 2 |  📡 Sensors & Actuators **Sensors**:   * PT100 temperature (analog) * Pressure, force (analog) * Brightness, ultrasonic, acceleration (digital) * ON-OFF input sensor * Heart rate sensor   **Actuators**:   * DC motor * Step motor * ON-OFF outputs  🔗 Communication & Protocols  * **MQTT Broker & Client** (integrated in DL WORKSPACE) * **Modbus RTU RS485** support * **Wi-Fi Network Analyzer** * **Network Speed Meter** * **Packet Sniffer** for traffic analysis and security exercises  🧪 Example Exercise **Scenario**: A switch in one location controls a lamp in another via MQTT.   * Switch publishes status to topic OnOff * Lamp subscribes to OnOff and updates accordingly * Entire system simulated on one workstation using DevIoT, MQTT Broker, and DL WORKSPACE tools  💻 Programming & Development  * Compatible with **Arduino Platform** * Firmware includes:   + Auto sensor detection   + MQTT connectivity   + USB supervision   + Display and keyboard management * **C++ libraries** provided for:   + LCD display   + SPI sensors   + Ethernet/Wi-Fi interfaces  📚 Didactic Program **Basic Topics**:   * IoT system structure and applications * Sensors, actuators, and microprocessor control * MQTT protocol and client-server architecture * Application examples: home automation, telemedicine, industrial control   **Advanced Topics**:   * Firmware development via Arduino * Wired/wireless networking * OSI model and protocol layers * HTTP and MQTT integration * Web client development (HTML, JavaScript) * Database use (SQLite) |

## 🔥 DL DM91 – Ignition System Training Panel

🔗

### 🎯 Purpose

Designed for **theoretical instruction and hands-on maintenance training** in vehicle ignition systems, especially for **vocational skill schools and technical colleges**.

### 🧰 Included Ignition Systems

The panel features **six real, operable ignition systems**:

1. **Mechanically timed ignition system**
2. **Hall effect electronic ignition system**
3. **Magnetic trigger electronic ignition system**
4. **Optical trigger electronic ignition system**
5. **Distributorless ignition system** (each coil serves two spark plugs)
6. **Distributorless ignition system – Coil-On-Plug**

### ⚙️ Technical Specifications

| **Feature** | **Description** |
| --- | --- |
| Dimensions | 1900 × 2400 × 700 mm |
| Weight | ~200 kg |
| Input Power | AC 220V ±10%, 50Hz |
| Operating Voltage | 12V DC |
| Temperature Range | -40°C to +50°C |
| Frame | Steel base with pivoting wheels |
| Panel Material | 4mm aluminum-plastic, co |

### 🧪 Functional Features

* **Real-time signal detection terminals** for measuring:
  + Resistance
  + Voltage
  + Current
  + Frequency
* **Intelligent fault setting system**:
  + Simulates faults
  + Enables troubleshooting exercises
* **Circuit diagrams** printed in fade-resistant color
* **No battery required** – converts 220V AC to 12V DC internally for safety

### 🔍 Recommended Accessories (Not Included)

* Digital Multimeter
* Automotive Oscilloscope

### 📚 Learning Outcomes

* Understand ignition timing and spark delivery
* Analyze ignition system behavior using real components
* Practice fault diagnosis and repair
* Explore micro-electronic control in modern ignition systems
* Apply knowledge to various vehicle types: cars, SUVs, motorcycles, trucks

Would you like help integrating this into a **training curriculum**, **assessment framework**, or **practical module** for trade test prep? I can also help simulate fault scenarios or build diagnostic checklists based on this panel.

## 💧 DL DKL091H – Computerized Water Hammer Trainer

🔗

### 🎯 Purpose

To study and visualize the **water hammer phenomenon** in hydraulic systems, including pressure surges caused by sudden valve closures or pump shutdowns.

### 🧪 Training Objectives

* Observe pressure changes due to flow variation
* Study positive/negative water hammer effects
* Analyze surge tank attenuation
* Determine speed of sound in water
* Measure head losses in pipes

### ⚙️ Technical Features

| **Component** | **Specification** |
| --- | --- |
| Pipes | PVC Ø28.4 mm, Copper Ø26 mm, both 3 m long |
| Pressure Transducers | 3× (0–10 Bar), 2× (0–16 Bar), 1× (0–5 Bar) |
| Valves | 1″ brass valve, Ø32 mm PVC ball valve (interchangeable) |
| Surge Tank | 1.7 m height |
| Data Acquisition | USB module for PC connection |
| Power Supply | 230V / 50 Hz |
| Additional Requirement | Compressed air line or air compressor |

### 🧰 Required Accessory

* **DL DKL014 – Hydraulic Bench**: Mobil

### 🎯 Purpose

To study **thermodynamic transformations** of air in a central HVAC system, including cooling, heating, humidification, and airflow dynamics.

### 🧪 Training Objectives

* Understand air treatment processes: temperature, humidity, flow
* Analyze heat exchange and energy efficiency
* Explore industrial and domestic HVAC systems

### ⚙️ Technical Features

| **Component** | **Description** |
| --- | --- |
| Structure | Tabletop aluminum frame |
| Air Unit | Transparent duct, axial fan, cooling/dehumidification coil, humidifier, heating coil |
| Sensors | Temperature, relative humidity, anemometric (airflow) |
| Circuit Diagram | Color-printed hydraulic schematic |
| Expansion Valve | Thermostatic type |
| Connectivity | Quick-connect cocks for integration with DL TMACM-RS base trainer |

## Would you like help integrating these into a **fluid mechanics curriculum**, **HVAC technician training**, or **trade test prep**? I can also help simulate fault conditions or create lab worksheets for hands-on learnin🧪 De Lorenzo DL CH Series – Chemical & Process Engineering Modules

| **Code** | **Module Name** | **Purpose & Highlights** |
| --- | --- | --- |
| **DL CH12** | Combined Chemical Reactor | Study of chemical reactions in both stirred tank and tubular reactors. Includes temperature control, conductivity probes, and SCADA integration |

* **DL RENLAB – Renewable Energies Laboratory**
* **Purpose**: To provide hands-on and theoretical training in sustainable energy systems, integrating solar, wind, fuel cell, hybrid, and smart grid technologies.
* **🧩 Core Modules & Systems**

| **Category** | **Module Code** | **Description** |
| --- | --- | --- |
| **Photovoltaic Systems** | DL SOLAR-AT / DL SOLAR-PV | Advanced trainers for solar panel performance, measurement, and grid integration |
| **Wind Systems** | DL WIND-A2 / DL WIND-B / DL VAWT / DL GMLL | Includes horizontal and vertical axis turbines, wind tunnels, and Savonius/Giromill models |
| **Hybrid Systems** | DL SUNWIND-A2 / DL SUNWIND-24V3 | Combines solar and wind energy for off-grid applications with battery storage |
| **Fuel Cell Systems** | DL HYDROGEN-B / DL HYGEN | Hydrogen-base |
| |  |  |  | | --- | --- | --- | | **Wind Systems** | DL WIND-A2 / DL WIND-B / DL VAWT / DL GMLL | Includes horizontal and vertical axis turbines, wind tunnels, and Savonius/Giromill models | | **Hybrid Systems** | DL SUNWIND-A2 / DL SUNWIND-24V3 | Combines solar and wind energy for off-grid applications with battery storage | | **Fuel Cell Systems** | DL HYDROGEN-B / DL HYGEN | Hydrogen-based energy conversion with integrated generators and safety systems | | **Solar Thermal Systems** | DL THERMO-A12 / DL GEOTHERM | Trainers for water heating, geothermal energy, and heat transfer analysis | | **Smart Electrical Systems** | DL SPH-33 / DL WPP / DL SPP / DL SGWD2.0-W | Includes Pelton turbines, solar/wind power plants, and smart grid microgeneration |  🧠 Educational Scope **Disciplines Supported**:   * Electronics & Energy Engineering * Sustainable Development * Environmental Technology * Power Systems * Renewable Energy Technician Training   **Learning Outcomes**:   * Design and simulate renewable energy systems * Analyze energy efficiency and sustainability metrics * Integrate smart grid technologies with renewable sources * Understand hybrid system dynamics and off-grid solutions * Apply fuel cell principles in clean energy generation  🖥️ Digital & E-Learning Integration  * **DL SMART Series**: Virtual courses and simulators for:   + Electric machines (DL OPENLAB-SSEM)   + SCADA systems (DL SMART-SCADA)   + AI in energy (DL SMART–AI)   + Civil and industrial electrical installations * **DL VPC-LAB4.0**: Smart simulator for process control with PID, ON-OFF, and hysteresis modeling | | |

* **🧪 Lab Configuration Example**

| **Station Type** | **Qty** | **Includes** |
| --- | --- | --- |
| Professor Station | 1 | Desk, chair, PC, printer, interactive whiteboard |
| Student Stations | 30 | Chairs, PCs, benches, renewable energy modules |
| Bench Size | DL 1001-1-08 | 2m × 1m × 0.8m |

* Would you like help designing a **custom curriculum**, **lab layout**, or **training proposal** for your institution or trade test prep? I can also help simulate hybrid systems or smart grid scenarios using Modbus, MQTT, or SCADA protocols.