# Research Laboratories and Educational Facilities

| | Laboratories and educational facilities | Equipment – Most Significant Instruments, Computers, etc. |
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| **1** | **Laboratory of Long-Term Corrosion Testing** | • Salt spray chamber Angel Antony DCTC 1200<br>• Four-channel potentiostat Biologic VSP<br>• Conductivity meter and pH meter ADWA 1020<br>• Digital refractometer MA866 for NaCl content determination<br>• Digital photometers Mi414 and Mi408 for Cl and Fe Ion determination<br>• Non-contact thermometer Fluke 568<br>• Reverse osmosis |
| **2** | **Laboratory of Bionics I** | • Struers Secotom 50 cutting machine with electronic control of the cutting process<br>• Struers Tegramin 30 metallographic preparation system - microprocessor-controlled, semi-automatic system for preparing metallographic, biological, and mineralogical samples |
| **3** | **Chemistry Laboratory of Organic and Inorganic Materials** | • Multiparameter measuring instrument inoLab pH/cond Level 1<br>• Abbe refractometer AR 2<br>• Multifunctional digital scale GF-300<br>• Ultrathermostat UH8<br>• Laboratory oven<br>• Laboratory fume hood<br>• pH meter<br>• Dynstat |
| **4** | **Laboratory of Rheological Properties** | • Rheometer Physica MCR 301<br>• Helago laboratory fume hood<br>• Stereomicroscope<br>• Milling machine FPX-25E<br>• Hardness tester Shore THS 201D<br>• Thermostat Julabo F12<br>• Laboratory balance |
| **5** | **Laboratory of Metallographic Sample Preparation** | • Precision saw MTH MIKRON 3000 with digital measuring system DOS-100<br>• Automatic/manual abrasive cut-off saw Brillant 240<br>• Sample mounting press Struers CitoPress-1<br>• Alternative metallographic sample preparation unit using blue light Technotray CU<br>• Struers CitoVac vacuum impregnation device for samples<br>• Double-disc grinder Struers LaboPol-25<br>• Single-disc polisher MTH and Struers Dap-7<br>• Struers LaboPol-5 polisher with attachment for automatic Struers LaboForce-3 sample preparation<br>• Struers TegraPol-15 polisher with attachment for automatic Struers TegraForce-1 sample preparation, and automatic dosing and control system with database for storing up to 200 preparation methods, Struers TegraDoser-5<br>• Microscope EPITYP 2<br>• Helago laboratory fume hood<br>• Analytical balance |
| **6** | **Laboratory of Surface Properties Measurement** | • Microhardness tester Zwick/Roel + PC<br>• Nanohardness tester Bruker Hysitron Ti Premier<br>• Optical microscope EPITYP 2 and optical microscope Zeiss Metaval<br>• Optical microscope Neophot 21<br>• Scanning electron microscope TESLA BS 343<br>• Non-oxidizing metal evaporator/sputter coater Quorum Q150R ES<br>• Stereomicroscope (stereo magnifier) |
| **7** | **Laboratory of Electron Microscopy** | • Scanning electron microscope TESCAN VEGA II LMU<br>• EDX analyzer Bruker |

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| **8** | **Laboratory of Optical Microscopy** | • 2x Metallographic microscopes NEOPHOT 32<br>• Digital cameras Nikon DS-FI1 and ProgRes CT3<br>• 2x PCs with NIS Elements software<br>• Metgraf software and Lexikon of Metals 1.6<br>• Stereomicroscope Motic with Moticam 1000 camera<br>• Digital camera NIKON Coolpix 4500<br>• Light microscope Carl Zeiss Axio Observer Z1m with automatic X, Y, Z motorized stage (automatic mosaic with extended depth of field)<br>• AxioVision 4 software with Materials package, phase analysis module, cast iron analysis module, and topography module |
| **9** | **Laboratory of Metal Corrosion** | • Voltalab 10 electrochemical measurement system<br>• Elcometer coating thickness gauge<br>• Control unit with rotating electrode CTV101<br>• Mettler Toledo XS205 analytical balance (dual range)<br>• Marlus reverse osmosis<br>• Lauda Proline RP870 cooling unit<br>• Ametek 31A/160V DC power supply<br>• Helago HD12 laboratory fume hood<br>• Cofomegra Solarbox 1500E UV chamber |
| **10** | **Laboratory of Mechanical Testing Light Facility** | • Brinell-Epignost microscope<br>• Hardness Tester:<br>  ○ Brinell CV-3000LDB<br>  ○ Vickers HPO 250/AQ<br>  ○ Vickers WSPN<br>  ○ Rockwell RR-1D/AQ<br>  ○ 3x Rockwell RRIV<br>  ○ portable hardness tester TH-170<br>  ○ universal hardness tester BVR 250 N<br>• Poldi hammer<br>• Universal tensile testing machine ZDM 10<br>• Thickness gauge Sonagage III<br>• Ultrasonic flaw detector Starman DiO 562<br>• Magnetic particle detector Inkar HD 400<br>• Digital camera Canon PowerShot SX40 HS<br>• Digital video camera Sony HDR-PJ740VE |
| **11** | **Laboratory of Mechanical Testing Heavy Facility** | • Universal tensile testing machine ZDM 30<br>• Dynamic pulsator Zwick<br>• 2x Charpy impact hammer PSW<br>• Rotoflex fatigue testing machine<br>• LAC heat treatment furnace<br>• LaborTech climatic chamber<br>• 2x lathes<br>• Proma E1516B/400 pillar drill<br>• Proma PPK-115 band saw<br>• Herzog grinder<br>• Sheet metal shears<br>• Makita HP1630K drill |
| **12** | **Laboratory of Internal Damping** | • Unique device for internal damping testing VTP-A |
| **13** | **Laboratory of High-Intensity Ultrasound** | • 2x KAUP-ŽU fatigue testing devices |
| **14** | **Laboratory of Information Technology** | • 20x PCs<br>• Software: MS Office, AutoCAD, Monaco, MS Visio |
| **15** | **Laboratory of Industrial Innovation** | • 20x PCs<br>• Software: MS Office, AutoCAD, QPR ProcessGUIDE, QPR EAXpress, QPR BSC, MS Project, MS Visio, visTABLEtouch, Tecnomatix Jack, Plant Simulation, Mind Map |
| **16** | **Laboratory of Production Systems and Process Design** | • 20x PCs<br>• Software: MS Office, MS Project, AutoCAD, Monaco, QPR BSC, Process Designer, Process Simulate, Plant Simulation, Simio, Factory CAD, Factory Flow, Visual Components |

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| **17** | **Laboratory of Digital Enterprise** | • 3x VR-Ready computers for VR development and testing<br>  ○ 2x HTC Vive Pro VR headsets<br>  ○ 1x Meta Quest 3 VR headset<br>  ○ 1x Meta Quest 1 VR headset<br>• VR KAT walking simulator<br>• Microsoft HoloLens mixed/augmented reality glasses<br>• Matter and Form 3D scanner V2<br>• Ricoh Theta Z1 360° camera<br>• Infinity 360 virtual tour creation kit<br>• Creality CR-10 MAX 3D printer<br>• Software:<br>  ○ 3D modeling<br>  ○ 3D scanning<br>  ○ interaction programming<br>  ○ interactive AR and VR application development<br>  ○ virtual tour creation |
| **18** | **Simulation and 3D Design Laboratory of Production Systems** | • 12x high-performance PCs<br>• Static and mobile RTLS system for real-time object tracking<br>• Prototypes of mobile robotic systems for automation development<br>• Fischertechnik modular systems for physical process simulation<br>• Mixed reality headsets Oculus Quest 3 and Vive XR Pro<br>• Forklift movement simulation hardware and software<br>• ProgeCAD and Leica Cyclone EDU software for layout and 3D modeling<br>• Visual Components and Tecnomatix Plant Simulation software for designing, simulating, and optimizing manufacturing and logistics systems |
| **19** | **Laboratory of Ergonomics** | • 1x PC<br>• SIEMENS Tecnomatix Jack 7.1 for ergonomic design and analysis<br>• 3D projection system for virtual animations of workspace models and human figures (3D projector and 3D glasses)<br>• Lean Tek systems Trilogiq (two workstations and rack stacker) for ergonomic design, work measurement and time studies, load and strain analysis<br>• Lutron dynamometer for measuring the force exerted by a person<br>• Ergometer for dynamic evaluation of human resistance to physical effort<br>• Voltcraft environmental measurement instruments - lighting intensity, noise levels, temperature, humidity |
| **20** | **Laboratory of Production and Logistics Systems Automation** | • Robotic line – Mitsubishi RV-12SD industrial robots<br>• Industrial conveyors<br>• SICK industrial cameras<br>• Logistics simulator<br>• Visual Components - 3D simulation and optimization software tool for industrial processes, focusing on automation and robotics |
| **21** | **Laboratory of FEM Analysis and Computer Simulations** | • PC: AMD Ryzen 9 7950X3D, RAM 128GB, NVME: 2GB, RAID5 30TB 6x4TB<br>• 3x PC: IBM 3750, 32 cores per server, 256 GB RAM, 12 HDD 500 GB RAID 5<br>• Software: ANSYS, MATLAB, FREECAD, GMESH, CALCULIX, ADINA, MSC.MARC, MSC.AUTOFORGE, MSC.FATIGUE, MSC.ADAMS |
| **22** | **Laboratory of Computational Mechanics** | • 10x PCs with quad-core processors, 16 GB RAM, and 500 GB SSD storage<br>• Software: ANSYS, MATLAB, MSC.ADAMS, LabVIEW |
| **23** | **Laboratory of Mechanical Systems Modeling** | • 16x PCs with quad-core processors, 16 GB RAM, and 500 GB SSD storage<br>• Software: ANSYS, MATLAB, MSC.ADAMS, LabVIEW |
| **24** | **Laboratory of Experimental Mechanics** | • NI cDAQ data acquisition system with 24-bit modules, NI 9234 Module (accelerometers, 4DI, 51.2 kS/s per channel, 102 dB dynamic range, anti-aliasing filtering ); NI 9237 (strain gauges, 4DI, VV 2012, 4/16 50 S/s/ch), NI 9219 (thermocouples, RTD, voltage, current, 100 S/s simultaneous sampling per channel, 50 S/s per channel for thermocouples), NI 9213 (thermocouples, 16DI, 1200 S/s)<br>• PCI-based measurement systems, NI PCI-4472 / NI PCI-4472B (8 DI, 102.4 kS/s/ch, 24-bit resolution with 110 dB dynamic range, software-configurable |

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| | | AC/DC coupling and IEPE power, variable anti-aliasing filters), NI PCI-6221 multifunction DAQ card, used for general-purpose data acquisition and control tasks 16SE/8DI, 250kS/s, 24 DIO, 2 AO, 16-Bit)<br>• Portable laser Doppler Vibrometer PDV 100 (0.5Hz-22.5kHz)<br>• Modal shaker TIRA 200N with amplifier<br>• High-speed infrared thermographic camera FLIR SC7500, cooled InSb detector with resolution 320 × 254 pixels, 380 Hz frame rate up to 28.8 kHz with windowing, thermal sensitivity < 20 mK, ResearchIR Max3 software, 2-channel acoustic emission system PAC PCI2, 18-bit resolution, 1 kHz to 3 MHz simultaneous sampling, AEwin software<br>• Multiaxial fatigue testing machine for combined bending-torsion<br>• INOVA 15060 multiaxial fatigue testing machine for combined tension-compression and torsion<br>• Software: LabVIEW (National Instruments), ME'ScopeVES 5.0 (Vibrant Technology) |
| **25** | **Laboratory of CNC and Production Digitization – DigiLabCNC** | • CNC vertical milling center Hurco VMX30t (4-axis)<br>• CNC lathe Hurco MT8<br>• CNC lathe Mazak NEXUS 100-M (4-axis)<br>• Dynamic phenomena measuring device KISTLER<br>• Universal lathe SUI 40 and milling machine FA4V<br>• Semi-automatic band saw BOMAR 320.250 DGH<br>• Vertical Milling Center STAMA MC325<br>• Lathe SN55<br>• Electric Shears NTV 2000/4<br>• Threading tool<br>• TIG welding machine<br>• Acceleration head for drives<br>• Surface Grinder BPH 20<br>• Cylindrical Grinder BUD 750<br>• Polisher<br>• Metallographic saw<br>• Magnetic table Tecnomagnete SpA<br>• Centrifugal grinding mills<br>• Measurement computers with high-speed Advantech measurement cards and DASY Lab software |
| **26** | **Laboratory of Nondestructive Testing – XrayLabNDT** | • X-Ray diffractometer<br>• Thermal imaging camera Mobir M8<br>• Hardness tester TH 160<br>• Hardness tester (HB Tester) |
| **27** | **Laboratory of Contact Metrology and Diagnostics – CMDLab** | • 3D CMM ECLIPSE with RDS CAA<br>• Surface roughness tester Mitutoyo SJ400 and Mahr 310<br>• Contour measuring instrument Conturecord 1700 SD3 ZEISS<br>• Laser interferometer XL80<br>• Renishaw software for automatic machine tool diagnostics<br>• TALYROND 73 – roundness measuring instrument<br>• Municipal measuring devices |
| **28** | **Laboratory of Surface Engineering – 3DScanLab** | • Alicona Infinite Focus G5<br>• ZOLLER V720j measuring device<br>• Zeiss Stereomicroscope |
| **29** | **Laboratory of Additive Manufacturing – LabAM** | • HP Jet Fusion 5210 3D Printer + Accessories<br>• Markforged 3D Printers |
| **30** | **Laboratory of Creative Technologies and Prototyping – StudyProtoLab** | • Workstations + software<br>o CALYPSO<br>o Reverse Engineer<br>o Gear<br>o PolyWorks<br>• 3D Printer Markforged |
| **31** | **Laboratory of Technological Design – TDLab** | • 3D Printers<br>o Bambulab X1 Carbon (X1C) |

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| | | ○ Bambulab P1S<br>○ Bambulab A1<br>○ CreatBot PEEK 300<br>○ Sinterit LISA<br>• 3D Scanners<br>○ Shining3D EinStar handheld<br>○ Leica<br>• Zeiss universal measuring microscope |
| **32** | **Laboratory of Thermal Processing** | • Electric laboratory furnace E + LM<br>• VF generator GV 11<br>• Double-chamber furnace DKO<br>• Muffle furnace RNO4<br>• Shaft furnace KPO 7/5<br>• Metallographic grinder META<br>• Epityp microscope<br>• Hardness testers Rockwell C, Rockwell B, and Rockwell RB-1 PC |
| **33** | **Laboratory of Casting** | • Electric induction melting furnaces<br>• Electric resistance melting furnaces<br>• Electric resistance chamber furnace for heat treatment of castings<br>• Device for determining hydrogen content in aluminum alloy melt (Density Index Method)<br>• Thermal analysis measurement system<br>• Measurement setup for determining alloy dilatation |
| **34** | **Laboratory of Forming and 3D Printing** | • Heating crucible furnace for samples up to 45 mm diameter<br>• Digitally controlled universal testing machine WDW 20 for static tensile testing<br>• Laboratory hydraulic press<br>• Device for testing material suitability for active parts of forming tools<br>• Deep drawing tool with active friction forces<br>• Device for measuring temperature during hot bending<br>• Device for influencing forging process by magnetic field and shearing tool in magnetic field<br>• Hydroforming drawing tool<br>• FDM 3D Printer Prusa i3 MK3<br>• FDM 3D Printer Anycubic Kobra 2 Neo<br>• SLA 3D Printer Anycubic Photon Mono M5s<br>• Elegoo Mercury XS Bundle cleaning and curing station with handheld UV lamp |
| **35** | **Laboratory of Robotic Welding** | • Welding robot KUKA VKR 200<br>• Welding robot Fanuc LRMate 200iD 4S<br>• Material handling robot Hyundai HX130<br>• Welding power source Transpulz Synergic 400 CMT with Robacta torch<br>• Welding power source Fronius MagicWave 2200 with Fronius KD 4000D-11 wire feeder<br>• Resistance spot welding equipment<br>• Measurement systems for monitoring welding power parameters and thermal cycles |
| **36** | **Laboratory of Arc Welding and Thermal Material Cutting** | • Fronius TransSteel 2200 welding inverter supporting MIG/MAG/MMA<br>• IWELD TIG 2400 AC/DC welding inverter<br>• CNC thermal cutting machine for plasma and oxyacetylene cutting<br>• Cebora PC 10054/T plasma cutting system with manual and machine torches<br>• Oxygen-acetylene kit for welding, brazing, and cutting |
| **37** | **Laboratory of Preparatory Operations and Model-Free Forming** | • Device for prototyping parts by computer-controlled casting<br>• Double-disc grinder<br>• Bandsaw Bomar ergonomic 275/230 DG<br>• Center lathe OPTIMUM D320x920 with a swing over bed<br>• Compressor Airprofi 1003/300/10H<br>• Drill-milling machine Opti 30 Vario |

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| | | • Bench Drill SV 13 |
| **38** | **Laboratory of Technological Process Evaluation** | • Digital microscope Keyence VHX-X1 with VH-Z100 lens<br>• Microscope NEOPHOT 2 with digital imaging<br>• Software for digital image processing: QuickPhoto Industrial<br>• Hardness tester:<br>  ○ Rockwell RB-1 PC/AQ<br>  ○ Brinell INNOVATEST NEXUS 3002 XLM<br>  ○ Innovatest Falcon 400<br>  ○ Microhardness tester INNOVATEST 412D<br>• Metallographic polisher KOMPAKT 1031 |
| **39** | **Laboratory of Nondestructive Materials Testing** | • Ultrasonic modular flaw detector OmniScan MX2 with PA and TOFD accessories<br>• Ultrasonic thickness measurement probes<br>• Visual inspection kit<br>• Handheld magnetic yoke with accessories for magnetic particle testing<br>• Dye penetrant testing kit |
| **40** | **Numerical Simulation Laboratory of Technological Processes** | • 7x HP All-in-One Workstations<br>• Software Licenses:<br>  ○ Sysweld Simulation Software<br>  ○ Procast Simulation Software<br>  ○ Simufact Simulation Software |
| **41** | **Laboratory of CAD Systems** | • 16x workstations with PTC Creo Parametric, PTC Windchill, Autodesk Inventor, ANSYS, MSC |
| **42** | **Laboratory of Bionics II** | • Olympus i-Speed 3 high-speed camera<br>• Olympus Iplex FX Videoscope<br>• Solver NEXT atomic force microscope<br>• Zeiss SteREO Discovery.V8 stereomicroscope<br>• Celestron portable digital hardness tester |
| **43** | **Laboratory of Rapid Prototyping** | • PolyJet Rapid Prototyping unit – OBJET EDEN 350V<br>• FDM Rapid Prototyping unit – Stratasys VANTAGE SE |
| **44** | **Laboratory of Rapid Prototyping / Laboratory of Tribology and Screw Joints** | • Rapid Prototyping units: SLS method – EOS Formiga P100, DLMS method – Renishaw AM 250, SLA method – ZBUILDER ULTRA, 3D Printing – ZPRINTER 650 and ZPRINTER 310 PLUS<br>• Device for measuring reliability of fastening of dynamically loaded screw joints<br>• Rotational microtribotester for sliding properties of tribological joints<br>• Linear tribotester for tribological properties<br>• Tribological testing equipment for layers and coatings in high vacuum<br>• PC-based measurement chain for strain gauge measurement of structures<br>• Optical measurement system IFD2401 for micro and nano distance measurement |
| **45** | **Laboratory of Experimental Plastometry** | • Static electromechanical testing machine LabTest 6.30<br>• Dynamic testing equipment<br>• Experimental equipment for severe plastic deformation (SPD) (ECAP+BP+US,etc.)<br>• Experimental device for contact pressure measurement |
| **46** | **Laboratory of Gearboxes, Transmission Components and Rolling Bearings** | • Test bench for verification of gearboxes and motors for mobile machinery<br>• Dynamometer 1/DS1020kW<br>• Torque sensors HBM 2 kN·m and 10 kN·m, speed, temperature, and pressure sensors<br>• PC-based measurement chain with PCLD 812 PG and OMD TC 5503<br>• Test bench for durability testing of large-scale bearings for wind turbines<br>• Test bench for axle bearing testing for high-speed railways |
| **47** | **Laboratory of Road Vehicle Diagnostics and Testing** | • MAHA MSR 1050 high-performance roller dynamometer test bench |
| **48** | **Laboratory of CAD/CAM/CAE Systems** | • 17x PCs / 20x workstations<br>• Software:<br>  ○ PTC Creo 10<br>  ○ AutoCAD<br>  ○ Matlab / Simulink<br>  ○ Fanuc Roboguide v. 9.0 / modul HandlingPro, WeldPro<br>  ○ Autodesk Inventor |

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| | | ○ SMC PneuDraw, FESTO FluidSim<br>○ Visual Components 4.1 (20 licenses) |
| **49** | **Laboratory of CNC Machine Programming** | • 11x PCs / 14x workstations<br>• CNC milling machine EMCO Concept Mill 105<br>• CNC lathe EMCO Concept Turn 55<br>• 3D Factories Easy3DMarker printer<br>• Prusa 3D Printer<br>• CAD/CAM system Edgecam 2024.2 (including versions 2011 and 2013) – 20 licenses<br>• CAD/CAM/CAE system Creo 10<br>• Workshop programming system Sinumerik Operate<br>• EMCO WinNC control software Sinumerik 840D<br>• EMCO WinNC control software Heidenhain TNC426/430<br>• Simulation operator panels EMCO – Sinumerik and Heidenhain |
| **50** | **Laboratory of Robotics in Manufacturing** | • Computer with Linux OS + ROS platform<br>• Laboratory automated assembly workstation (LPAM), equipped with SMC electropneumatic components, controlled by Unitronics Visio OPLC<br>• VisiLogic Software v9.3.0<br>• Fanuc LR Mate 200iC robot<br>• Fanuc R-30iB controller<br>• Fanuc Roboguide software v8.0<br>• Uniq PC and MES dispatcher software for remote LPAM control<br>• 2x OMRON F3S TGR CL2B safety light curtains<br>• Compressor DK 50-10<br>• Test workstation for spatial scanning + modular control system |
| **51** | **Laboratory of Mechanisms with Unconventional Kinematics** | • Prototype device with parallel kinematic structure – UNIZA-Hexapod<br>• Prototype device with hybrid kinematic structure – UNIZA-TriVariant<br>• Software for prototype control<br>• Control systems for 5- and 6-axis devices based on Siemens S7-300 and Sinamics S120<br>• Pneumatic System SMC |
| **52** | **Laboratory of Advanced Robotics** | • Development workstation with PC<br>• KUKA ready2_educate_vp_KR4 Robotic Cell with KUKA KR4 R600 Agilus Robot with KR C5 micro controller and KUKA PRO and Vision software package<br>• Robotic cell with universal robots UR10<br>• Prototype tracked mobile robot with AI Systems/ neural network systems for autonomous navigation, decision making, etc. |
| **53** | **Laboratory of Mechatronic Systems** | • 11x PCs<br>• 7x PLC training stations, equipped with Unitronics Vision 120 OPLC, PT100 temperature sensor and capacitive sensor<br>• Software: VisiLogic v9.3.0 / CodeVision, FANUC Roboguide v9.0 + Auto Place v8.0, Visual Studio, SMC PneuDraw<br>• Pneumatic workbenches: 2x SMC Pneutrainer-400 configured with PNEU-402 (Advanced Pneumatics Set) and PNEU-404 (Advanced Electro-Pneumatics Set) and 2x Pneutrainer compressors<br>• SMC Sensotrainer-200 sensor kit<br>• Delta robot FANUC M1-iA equipped with integrated Sony XC-56 vision system, end-effector, and suction gripper<br>• Mobile collaborative wheeled robot prototype designed for inter-operation transport with differential steering and onboard power system<br>• Parallel kinematic hexapod prototype<br>• Robotics tools for educational purposes: end-effector demonstrations by Sommer Automatic, hardware samples from Fanuc robots (arm, drive units, sensors, and brake systems), pneumatic actuators from SMC, frequency |

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| | | converters and drive modules, Kinect sensor<br>• 8x Development modules EVB 4.3<br>• Development module EASY AVR 6<br>• Delta robot prototype Caertec rk2010 with control system and simulation software<br>• Hybrid kinematic TriVariant prototype<br>• Experimental mobile robots (iRobot Roomba, wheeled mobile robots with omnidirectional and differential steering, legged walking robots, drones)<br>• Industrial robot simulation programs (TriVariant v9.exe, HEXAPOD prototype simulation v1.0.exe, RoboSim2.exe and mobile robot simulation program (MobilnyRobot.exe)<br>• Electronic systems assembly workstation (soldering station, digital logic analyser, multimeter) |
| **54** | **Laboratory of Machine Vision and Artificial Intelligence** | • 13x PCs<br>• Software: Autodesk Inventor<br>• 3D camera system including SICK IVC-3D51112 camera, Sick Ruler E2221, Sick LMS400 - laser measurement system<br>• Optical sensors: Keyence LS-7070 optical micrometer, Keyence LJ-G200 optical profilometer<br>• 2D camera system: Balluff Matrix Vision camera with accessories, set of lenses, additional lighting modules |
| **55** | **Laboratory of Production and Development** | • Prototype device<br>o UNIZA book dispensing machine<br>o Robotized shoe trimming machine<br>o Measuring equipment for heel cables, prototype No. I<br>• Robot KUKA KR16-2 with KR C4 controller<br>• Pneumatic laboratory compressor Pneutrainer<br>• Tool set |
| **56** | **Laboratory of NC Machine Tool Accuracy Measurement and Diagnostics** | • 5x workstations with PCs<br>• Renishaw XL-80 Laser interferometer<br>• Ballbar QC20 for circular interpolation accuracy measurement<br>• Spirit Wyler Level for checking and adjusting the leveling and setup of machine<br>• POWER TEST indicator for measuring clamping force |
| **57** | **Computer Laboratory I** | • 18x PCs<br>• Behringer mixing console and speaker<br>• Software: MATLAB |
| **58** | **Computer Laboratory II** | • 18x PCs<br>• Behringer mixing console and speaker<br>• Software: MATLAB |
| **59** | **Laboratory of Transportation and Handling Technology** | • Overhead crane, 12.5-ton capacity<br>• RAILBCOT – Rail vehicle brake component test bench<br>• Equivalent railway operational load simulator<br>• Test bench control center |
| **60** | **Laboratory of Heavy Rail Vehicles** | • UIC flywheel brake test bench |
| **61** | **Laboratory of Internal Combustion Engines** | • Measurement equipment for vehicle dynamics and related parameters (consumption, fume quality, etc.)<br>• Subassemblies of automobiles for testing (front and rear axles, 2x drive units, dashboard with control and operating elements, etc.)<br>• Measurement device for testing vehicle dynamics (Datron DAS 3 central unit + accessories)<br>• Vehicle engine diagnostic set (WOW IQ 310)<br>• Mobile set for indicating vehicle measuring systems (SM)<br>• Car (2x KIA, Citroen C6, VW model) |
| **62** | **Laboratory of Technical Diagnostics** | • Diagnostic panels for fault detection in automotive systems<br>• Diagnostics for KIA cars |

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| | | • Training stand for freight wagon brake equipment DAKO GP-A and pneumatic brake simulator |
| **63** | **Light Rail Vehicles Laboratory – CAx Technologies Unit** | • 10x PCs<br>• Software: MS Office, Dassault Systems CATIA, SIMPACK, ANSYS |
| **64** | **Laboratory of Light Internal Combustion Engines** | • Educational models of internal combustion engine parts |
| **65** | **Transport Mini-Laboratory** | • Model railway educational kits<br>• Digital control systems for model railways |
| **66** | **Laboratory of Environmental Measurement** | • Ahlborn measurement central unit + measurement computer<br>• 10x temperature sensors<br>• 5x flow sensors<br>• Flowmeter ±1% uncertainty<br>• Digital Scale up to 500 kg<br>• Infrared gas analyzer Madur<br>• Fuel moisture measurement device<br>• 2x Electronic overpressure sensors Ahlborn<br>• Controltron ultrasonic flow sensor<br>• 2x Infrared temperature sensors<br>• Ahlborn meteorological station<br>• Tube furnace L T50/750/13<br>• Chilled thermostat |
| **67** | **Laboratory of Anemometry** | • PIV Dantec – particle image velocimetry system for fluid flow visualization<br>• CTA – hot-wire anemometer for fluid velocity measurement<br>• UPV Duo – ultrasonic velocity profile meter |
| **68** | **Laboratory of Low-Potential Heat Appliances** | • Thermostatic chamber<br>• 6x Strain gauge pressure sensors<br>• 2x Flow sensors<br>• Coriolis mass flowmeter<br>• Binder MKF720 test chamber<br>• Circulating cooler FLW11006<br>• Dry cooler SHLN-165D<br>• Cooling tower<br>• Cryostat FP40-HE |
| **69** | **Laboratory of Heat Sources** | • Cooling device<br>• 2x Ahlborn measurement central unit<br>• Measurement computer<br>• 20x Temperature sensors<br>• Infrared (IR) thermal camera<br>• 2x Flow sensors<br>• Exhaust emission measurement device<br>• Portable ultrasonic flow sensor<br>• Heat exchanger station with temperature control<br>• Stationary gas analyzer MOS400<br>• Strain gauge fuel consumption scale<br>• Hydrogen generator |
| **70** | **Laboratory of Alternative Heat Sources** | • Heat pump Vitocal 300 BW 106<br>• Heat pump Vitocal 300 BW 216<br>• Gas-powered air-to-water heat pump<br>• Meteorological station |