



EHTIC

European HealthTech
Innovation Center

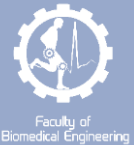


**Silesian University
of Technology**



Faculty
of Biomedical Engineering

Silesian University of Technology in numbers



**15 basic faculties
in three cities**

18 000

students

600 +

PhD students

200 000 +

graduates

1 620 +

academic staff

120 +

full-professors

3 150 +

employees

Faculties

Gliwice



Architecture



Automatic Control, Electronics
and Computer Science



Civil
Engineering



Chemistry



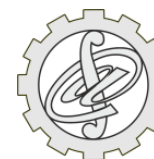
Electrical
Engineering



Mining, Safety Engineering
and Industrial Automation



Mechanical
Engineering



Applied
Mathematics



Energy and
Environmental
Engineering



Institute of Physics –
Centre for Science and
Education



Institute of Education
and Communication
Research

Zabrze



Biomedical
Engineering



Organization and
Management

Katowice



Transport and
Aviation Engineering



Materials
Engineering



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Faculty of
Biomedical Engineering

The beginnings biomedical engineering discipline at Silesian University of Technology



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Pierwszy krajowy defibrylator elektroniczny regulujący pracę serca wykonano na Politechnice Śląskiej

Urządzenie elektroniczne zwane defibrylatorem, służy jako źródło emisji impulsów elektrycznych, podtrzymujących i stabilizujących prawidłowość działania serca. Ma ono zastosowanie głównie przy wykonywaniu zabiegów chirurgicznych na odsłoniętym sercu.

Defibrylatory dotąd nie były wytwarzane w kraju, a z uwagi na ich wysoką cenę — nawet w krajach o wysokim rozwoju techniki — nie stanowią one standardowego wyposażenia wszystkich kardiologicznych zakładów leczniczych.

Twórcą pierwszego polskiego defibrylatora jest mgr inż. Karol Mosler, wykonawca — Zakład Optyki i Mechaniki Precyzyjnej Politechniki Gliwickiej.

Pierwszy defibrylator polskiej produkcji ofiarowany został klinice chirurgicznej Śląskiej Akademii Medycznej.

1966

the first Polish
defibrillator



artificial heart-lung
device

1968

1978

artificial kidney



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History of the Faculty of Biomedical Engineering

establishment of the specialization **Electronic Medical Equipment** at the Faculty of Automatic Control, Electronics and Computer Science

1969

establishment of specialization **Biomaterials and Medical Equipment** at the Faculty of Mechanical Engineering

1988

establishment of specialization **Biomechanics and Medical Equipment** and **Production Engineering of Rehabilitation Equipment**

1998

establishment of full-time studies in **Biomedical Engineering** at the Faculty of Automatic Control, Electronics and Computer Science

2007

establishment of the **Faculty of Biomedical Engineering**

2010

Assist Med Sport Silesia
Silesian Center for Engineering Support of Medicine and Sport

2020

EHTIC
European HealthTech Innovation Center
European HealthTech Innovation Center

2021



Silesian University of Technology



Faculty of Biomedical Engineering



Faculty of
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The only faculty of
BIOMEDICAL ENGINEERING
in Poland





Silesian Center for
Engineering Support of Medicine
and Sport

Key project in the Silesian Region co-financed by the EU funds



Total budget

9 mln €



16 mln €



25 mln €



16,5 mln €



4 mln €



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2 mln €



2,5 mln €



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Faculty of Biomedical Engineering



Department of
Medical Informatics
and Artificial Intelligence



Department of Biomaterials
and Medical Devices
Engineering



Department of
Biomechanics



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R&D laboratories



computer vision and
virtual reality



surgical procedures
planning



rapid prototyping



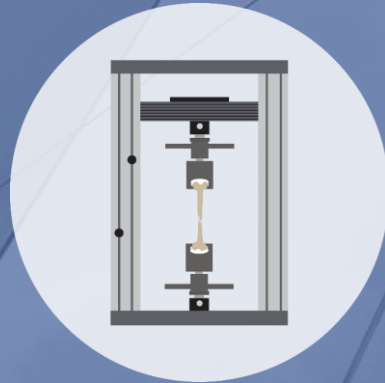
implant Surface
testing and
functionalization



biomorphic
materials



engineering support
in dentistry



mechanical testing
of medical devices



control and
measurement
systems and
biometrics



human locomotor
system research



biomechatronic
devices design
assistance

Computer Vision and Virtual Reality Laboratory

- a system for testing postural stability in static and dynamic conditions using virtual reality technology
- a system to support the rehabilitation process using VR technology
- 3D scanning system
- 3D cave system with the function of monitoring brain signals, eye movements, etc.
- Virtualisation server - data processing and analysis centre for computer clusters



Computer Vision and Virtual Reality Laboratory

- using the EMG signal to control a virtual reality application
- mobile diagnosis and therapy support system based on motion controllers
- spatial application software development
- spatial application graphics development system



Surgical Planning Laboratory

We carry out research in the field of assisted surgical planning with a particular focus on computer-assisted minimally invasive procedures. We prototype and develop systems for minimally invasive surgical procedures.

- operating theatre
- mobile ultrasound system
- Micro CT
- medical imaging analysis
- microscopic image analysis software
- image navigation system kit
- tele-transmission system
- biomanipulators and robotics
- engineering support for medical procedures



Rapid Prototyping Laboratory

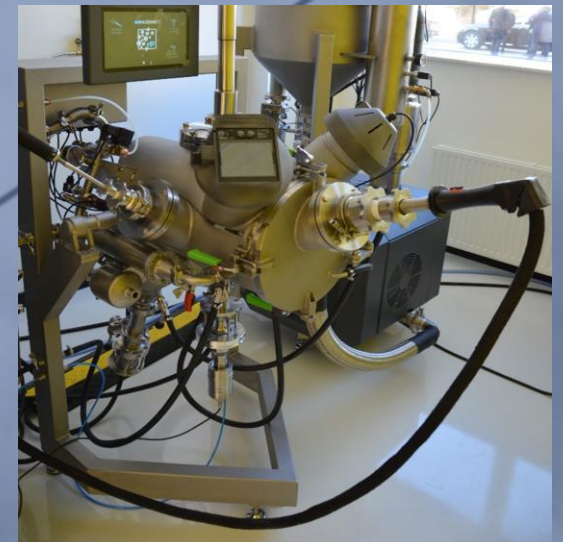
Developing and manufacturing new materials and personalised products with gradient structures for medical applications (orthopaedics, traumatology, spinal surgery, dentistry and rehabilitation)

3D printing technology for metals and polymer components:

- Direct Metal Laser Sintering,
- Selective Laser Sintering,
- Digital Light Processing,
- Fused Deposition Modelling/Fused Filament Fabrication,

Used in models, prototypes & final parts to be used in medical devices and a wide scope of diverse engineering applications (also, automotive, aviation & aerospace and energy industries).

We cover the whole prototype production process: 3D scanning for reverse engineering, 3D modelling and design, powder selection/metal powder production (gas atomizer), rapid prototyping, low-volume production, heat treatment of printed metal elements, sandblasters and ultrasound cleaners for post-processing.

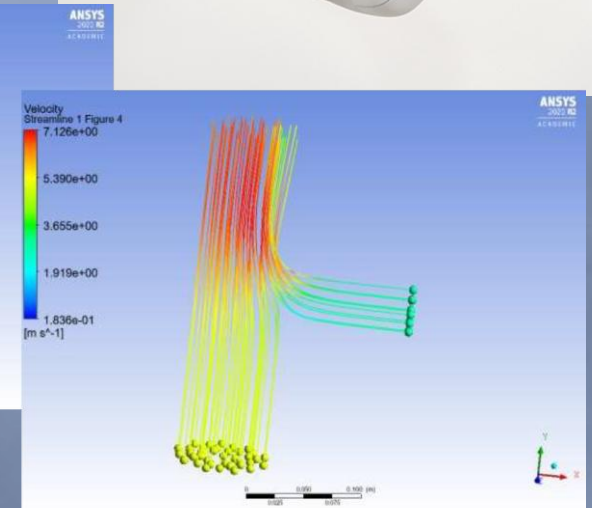
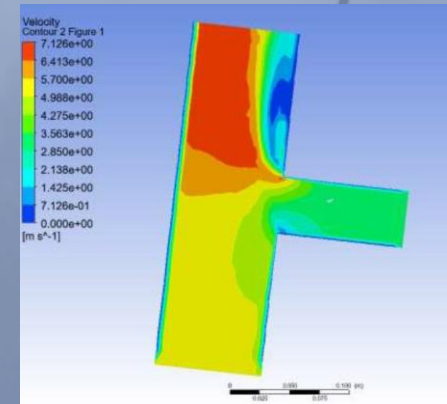


Biomechatronic Devices Design Assistance Laboratory

- research to support the design process of medical devices using **rapid virtual prototyping methods**.
- testing and evaluating the performance of actuators, electromechanical, mechanical, pneumatic and hydraulic systems for use in exoskeletons or robotic devices.
- research on robot, biomanipulator and human interaction in biomechatronic and medical applications.
- designing and prototyping, testing and measuring state-of-the-art biomechatronic devices, electronic and textronic components and devices.
- evaluating the strength properties of various materials and structural components.

Systems we use:

- CAD/CAM design
- Multi-physics calculation
- Reverse engineering
- Collaborative robots
- Prototyping system for biomechatronic devices
- Functional prototyping



Locomotor System Research Laboratory

- model tests and experiments for the diagnosis and objective assessment of the human musculoskeletal system
- qualitative and quantitative biomechanical analyses of various forms of movement, ranging from gait and everyday activities to complex movements characteristic of individual sports disciplines.
- analysing existing methods of physiotherapy and physical diagnosis and carry out research into the adaptation of workstations in the context of ergonomics.

The laboratory includes:

- **MOTION ANALYSIS**
 - ✓ optical motion analysis system
 - ✓ inertial motion analysis system
 - ✓ ground reaction forces and load distributions measurements
 - ✓ measurement of muscle activity using the EMG method
- **MUSCULOSKELETAL LOADS SIMULATION**
- **ERGONOMICS RESEARCH**
- **PHYSICAL THERAPY RESEARCH**



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Control & Measurement Systems and Biometrics Laboratory

- working on modern methods to support geriatric diagnosis using IT and telemedicine.
- research in the fields of anthropometry, biomedical signal analysis, concentration and attention disorders, and acoustic signal processing.
- designing, building and testing models and functional prototypes of innovative bioelectronic systems and complex control, measurement and simulation systems
- research on the use of artificial intelligence, machine learning and data visualisation in medicine and sport.



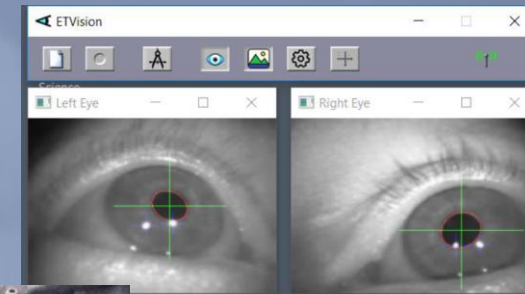
The laboratory includes:

BIOMEDICAL SIGNAL ACQUISITION & PROCESSING

- Functional Near Infrared Spectroscopy (fNIRS) Measurement System
- Perimed microcirculatory measurement system
- Detailed analysis of human body composition

PSYCHOPHYSICAL ASSESSMENT

- Measurement of EEG signal, gaze direction and EMG signal
- Studies of the effect of stimuli on the person and assessment of the degree of concentration on specific tasks/objects



Control & Measurement Systems and Biometrics Laboratory

PSYCHOPHYSICAL ASSESSMENT

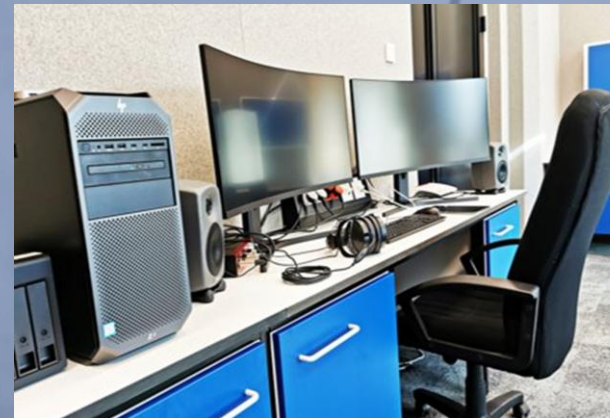
- Perimed PeriFlux 6000
- fNIRS BIOPAC System
- Visual stimulation kit
- Audio simulation kit

HEARING AND SPEECH RESEARCH

- Recording of speech signals
- Speech therapy diagnosis and therapy
- Audiological examinations
- Acoustic examinations
- Measurements room ($T_s = 0,2s$, $NR < 20$)
- Hearing room ($T_s = 0,25 - 0,35s$, $NR < 25$)

& MORE:

- ANTHROPOMETRY
- CARDIAC REHABILITATION SUPPORT STATION
- GERIATRIC SUPPORT
- BIOELECTRONIC SYSTEMS DESIGN & PROTOTYPING
- COGNITIVE SYSTEMS
- BIOINFORMATICS



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Biomorphic Materials Laboratory

We are working in the field of technology for the preparation of environmentally friendly biomorphic carbon/carbon and carbon/polymer composites and the characterisation of their physicochemical properties. The raw materials for the substrates of these composites come from renewable sources, such as fibre plants.

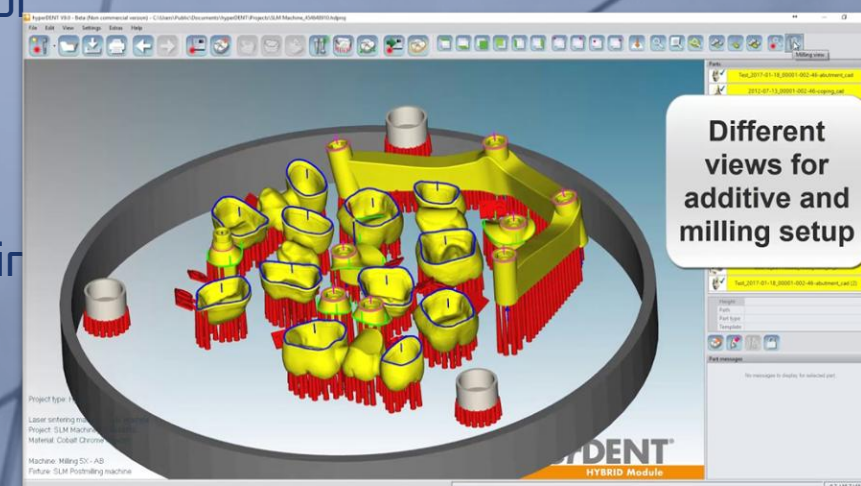


We are also researching the development of biosensor fabrication technologies using biocatalysts derived from biomorphic materials.



Dental Engineering Laboratory

- optimising the functional and aesthetic properties of prosthetic products made from all types of materials: metal, polymer and composite.
- milling services based on the image of the prosthetic base or the design of the prosthetic product in all groups of materials.
- tests under conditions that simulate dynamic changes in the physical conditions of the dental system.



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Laboratory for Mechanical Testing of Medical Devices

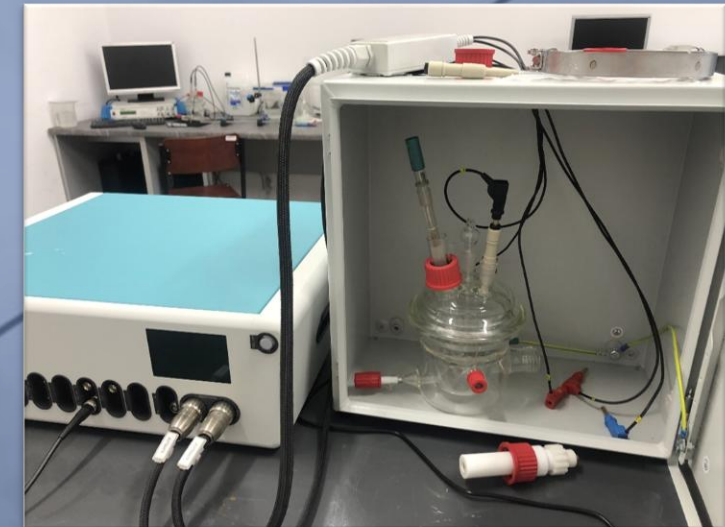
We perform tests to evaluate the mechanical properties of surface coatings applied to medical devices used in orthopaedics, traumatology, spondylolisthesis, minimally invasive surgery and dentistry. The assessment is based on abrasion resistance tests under conditions appropriate to the use of the devices.

The laboratory includes:

- **MECHANICAL PROPERTIES TESTING**

- Abrasion wear resistance tests
- Wear rate tests
- Coating thickness tests
 - Arbor for balls and pins with diameters: 1.5; 3; 6 and 10mm
 - Loads: 0.25N, 0.5N, 1N, 2N, 5N, 10N, 20N, 30N, 60N
 - Maximum test length 40 days
 - Indentation device
- In situ compression test
- Bending test "in situ"
- Scratch test "in situ"
- Nano-hardness measurement "in situ"

- **ELECTROCHEMICAL TESTING**



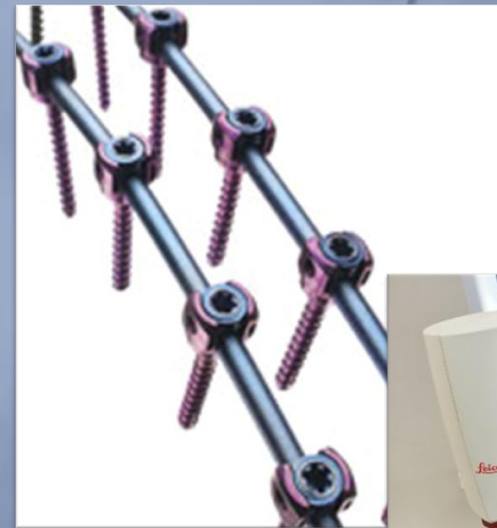
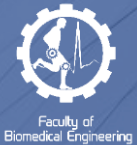
Implant Structure Testing Laboratory

We carry out structural studies on metallic, polymeric, ceramic and composite biomaterials, including those with surface layers and varying chemical and phase compositions. The facilities include a comprehensive metallographic sample preparation line.

The laboratory includes:

MICROSCOPIC SPECIMEN PREPARATION

IMPLANT STRUCTURE TESTING



Laboratory for Implant Surface Functionalization

We carry out research related to surface treatment and analysis of the properties of manufactured layers or coatings on medical devices. We also carry out work related to surface modification of medical devices under controlled technological conditions. We provide quality expertise to the medical, aerospace, energy and automotive industries.

The laboratory includes:

- CHEMISTRY LAB
- SURFACE FUNCTIONALIZATION
 - ✓ with the use of the Atomic Layer Deposition system - ALD
- PHYSICAL COATING APPLICATION
 - ✓ Exactacoat (SONO-TEK) - Ultrasonic coating system



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Thank you for your attention!



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