SCIENTIFIC POTENTIAL
Department of Biomaterials and Medical Devices Engineering

Head of the Department
Professor Zbigniew Paszenda
Department of Biomaterials and Medical Devices Engineering

Laboratories

- Laboratory of samples preparation
- Laboratory of testing electrochemical properties
- Laboratory of testing mechanical properties
- Laboratory of heat treatment
- Laboratory of integrated materials processing in dental prosthetics
Material study

- **Sample preparation**
  - Fully equipped line for metals, ceramics, plastics, composites

- **Microscopic observations**
  - Observation and characterization of damage surface
  - System for automatic image analysis
Material study

• **Study of mechanical properties**
  - Hardness, microhardness, ultra-nanohardness
  - Extension, compression, bending

• **Heat treatment**
  - Forming mechanical properties
  - Sterilization
Corrosion testing

- **Voltamperometric study**
  - Regular corrosion
  - Pitting corrosion
  - Stress corrosion
  - Crevice corrosion
  - Galvanic corrosion

- **Impedance study**
  - Electrochemical Impedance Spectrometry

- **Degradation study of plastics and ceramic materials**
Surface analyses

- Topography and surface roughness
  - Opical profilometer DCM 3D
  - Mechanical profilometer

- Thickness of surface layer
  - Elipsometer Woollam M2000

- Nanohardness of surface layer
  - Open platform CSM

- Adhesion of surface layer
  - Open platform CSM

- Friction wear
  - Pin on Disc

- Surface wettability
  - Surftens Universal
Virtual Reality

• 3D scanning
  ➢ reverse engineering
  ➢ design
  ➢ analysis

• Virtual imaging
  ➢ nVidia 3D VISION 2
  ➢ 3dsMAX
  ➢ Quazar3D
Technologies

Laboratory of integrated materials processing in dental prosthetics
Technologies

- **CAD-CAM system in dentistry**
  - 4 axis milling machine
  - 3D laser scanner
  - CAD software
  - Face bow

- **Foundry, metal and ceramics machining**
  - Induction foundry
  - Furnace
  - Electropolishing unit
  - Furnace for ceramics
  - ZrO₂ sintering furnace
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Major fields of scientific research

Mechanical, physiochemical and electrochemical study of biomaterials, implants and medical devices

Numerical and experimental methods applied in design of implants and medical devices

Corrosion and biodegradation of metal, ceramic and plastic biomaterials and implants

Research on advanced rehabilitation equipment
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Examples of research and application

Transpedicular screws for spine stabilization

anodic oxidation
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Examples of research and application

artificial heart prosthesis
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Examples of research and application

Plate for the correction osteotomy
Examples of designed implants

Spine Stabilizers

Double-threaded screws

Plate for limited contact

Intramedullary nail
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Examples of designed implants

Plate for treatment of deformations of the frontal wall of chest
Numerical simulations

- **Technical drawings**
  - AutoCad
  - Inventor

- **Finite Element Analyses**
  - Ansys

Plate for treatment of deformations of the frontal wall of chest

DHS Screw

Surgical drills

Endoprostheses of hip joint

Stent
Robotic systems for interactive neurophysiological rehabilitation and limbs diagnostics

Cooperation with Institute of Medical Technology and Equipment

Mechatronic device for conducting a multi-plane passive and active movement of lower limbs using neurophysiological methods

Systems for interactive neurophysiological rehabilitation and diagnostics of upper limbs dysfunctions

MECHATRONIC REHABILITATION DEVICES

Robotic rehabilitation device for conducting a multi-faceted passive and active movement of upper limbs using neurophysiological methods
Within the frames of the Assist Med Sport Silesia project the following laboratories are planned to be established:

- Laboratory of rapid prototyping
- Laboratory of testing implants structures
- Laboratory of implants surface functionalization
- Laboratory of engineering support in dentistry
- Laboratory of testing mechanical properties of medical devices
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4. Modeling and improvement of osteosynthesis techniques for treatment of osteoporotic fractures

- support systems to diagnose injury and dysfunction of musculoskeletal system
- selection of osteosynthesis and stabilization techniques of osteoporotic fractures and surgical instruments
- development of new implants with modified surfaces and high biocompatibility

COOPERATION WITH CLINICAL HOSPITAL
Robotic systems for diagnostics and interactive neurophysiological and cardiac rehabilitation

methods and devices to conduct controlled limb rehabilitation using a multi-plane active and passive movement

robotic devices for diagnosis and neurophysiological and cardiac rehabilitation
Programming and design of health care facilities and rehabilitation in particular zones for the diagnosis and treatment of elderly patients

architecture supporting processes of diagnosis and medical procedures a patient’s stay in space, also in the context of an elderly patient’s specific needs.

parameterization methods in programming the size of the hospital functional areas, including the diagnostic using modern medical devices and taking into account changes in technology and methods of patient care.
Thank you for your attention

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