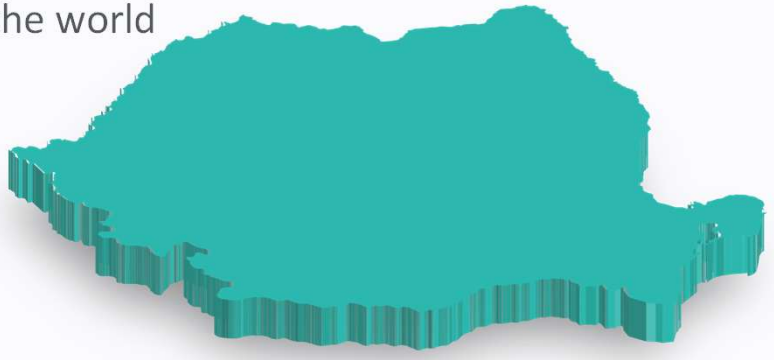
National University of Science and Technology POLITEHNICA Bucharest

- accelerating industrial revolutions -

Hello!

Romania

- 12th largest country in Europe by size
- 6th largest country in the EU by population (19.3 mil.)
- Official language Romanian – romance language
- 4th in EU by the average number of languages learned in upper secondary schools
- English and French – dominant foreign languages spoken in the country
- Fastest growing industry: IT, while Romania has one of the fastest internet infrastructures in the world



Hello!

Bucharest

- Political, economic and cultural center of Romania
- Largest city in Romania, with 1.8 mil inhabitants
- 4th largest city in EU
- It holds the second largest administrative building in the world – The Parliament Palace and many other impressive historical landmarks

WHO WE ARE

Tradition

The most prestigious technical university in Romania, with over 200 years of history

Research

The most important research center in the region, with outputs towards the private sector

Partner

An international partner to over 1.000 companies

Quality teaching and learning

40,000 students enrolled in BSc, MSc, and PhD studies

Over 4000 total staff; **over 1600** academic staff

21 faculties, **67** study programs in foreign languages

Bachelor

153 Bachelor's Degree Programs

Master

244 Master Degree Programs

PhD

19 Doctoral Schools

Grown locally, spread internationally

collaborating with universities from **over 100 countries**

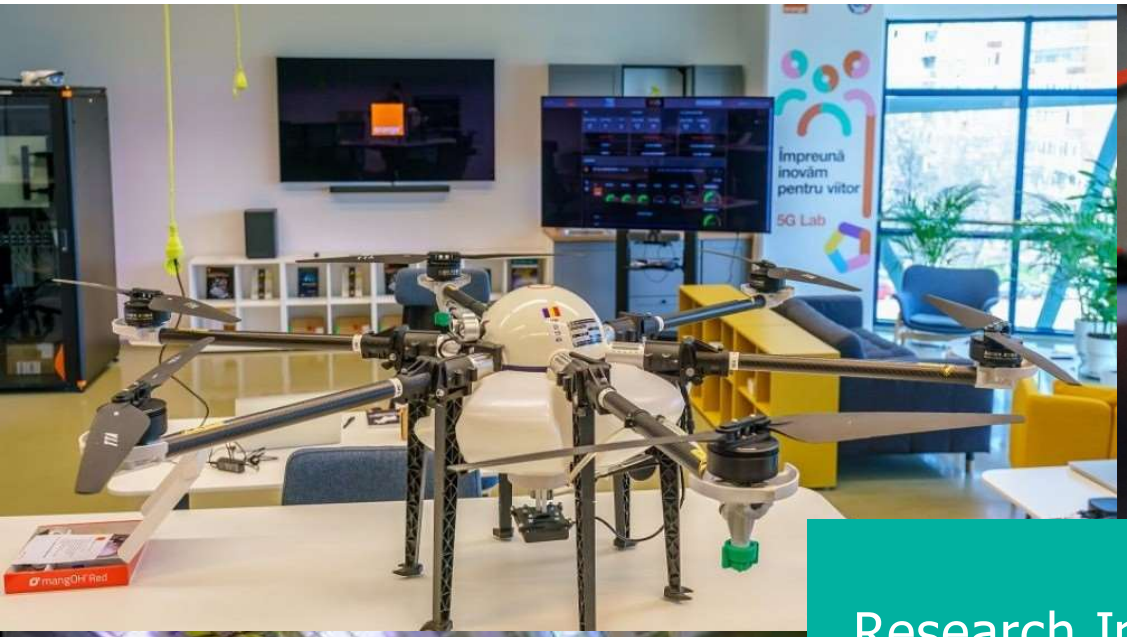
EELISA European University

Politehnica Bucharest is a member of EELISA (European Engineering Learning Innovation and Science Alliance) - the first alliance of Higher Education Institutions from different countries in Europe meant to define and implement a common model of European engineer rooted in society.

10 European partners and one Associated partner – ENAEE (European Network for Accreditation of Engineering Education)

eelisa
European University

https://eelisa.eu/



Research Infrastructure

Research at a large scale

Infrastructure

- 87 research centres
- 34,000 m2 dedicated to research
- 70 new state-of-the-art laboratories
- 115 pending patents
- Over 1,000 WOS publications yearly

Research at a large scale

- Over 500 implemented research projects in the last 3 years (2021-2023)
- 2 grants funded by European Research Council
- Projects funded from European Funds: almost 40% of the total university project funds;
- GEX and GNaC grants from Politehnica Bucharest own programmes - 225 research projects for young post-doctoral researchers;
- Politehnica Bucharest received the ‘HR Excellence in research’ in 2020 for implementing the Human Resources Strategy for Researchers (HRS4R)

Research at a large scale

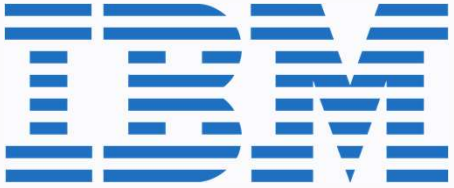
Through Romania's Recovery and Resilience Plan, Politehnica is currently implementing:

- 4 projects for the development of Competence Centers:
  - "Adaptation to Climate Change"
  - "A Soil Deal for Europe"
  - "Climate-Neutral and Smart Cities"
  - "Cancer"

- 7 research projects to attract highly specialized human resources from abroad

Component 9 - Support for the Private Sector, Research, Development and Innovation

Over 1000 partner companies



International Associations Membership

Mobility programs

European project semester

Erasmus+

Erasmus Mundus Joint Master Degree

ATHENS NETWORK
ADVANCED TECHNOLOGY
HIGHER EDUCATION NETWORK

Athens Network

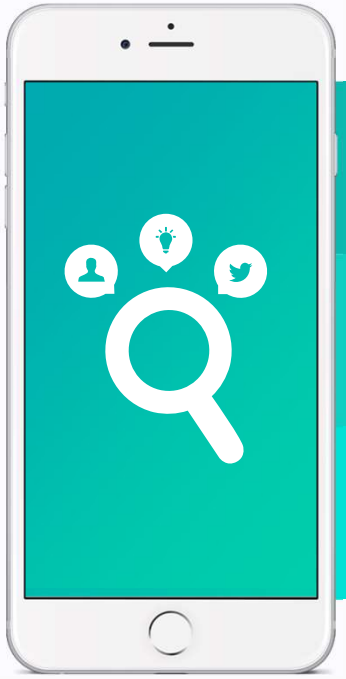
Double degree

A voice that cannot be ignored

UPB is renowned at the national and regional level. We do more than reach all media outlets. We are a media outlet.

Starting this year, UPB is launching **EURONEWS ROMANIA** - a voice for the European education. Stay tuned!

Important events within UPB will benefit from not just national, but international coverage.

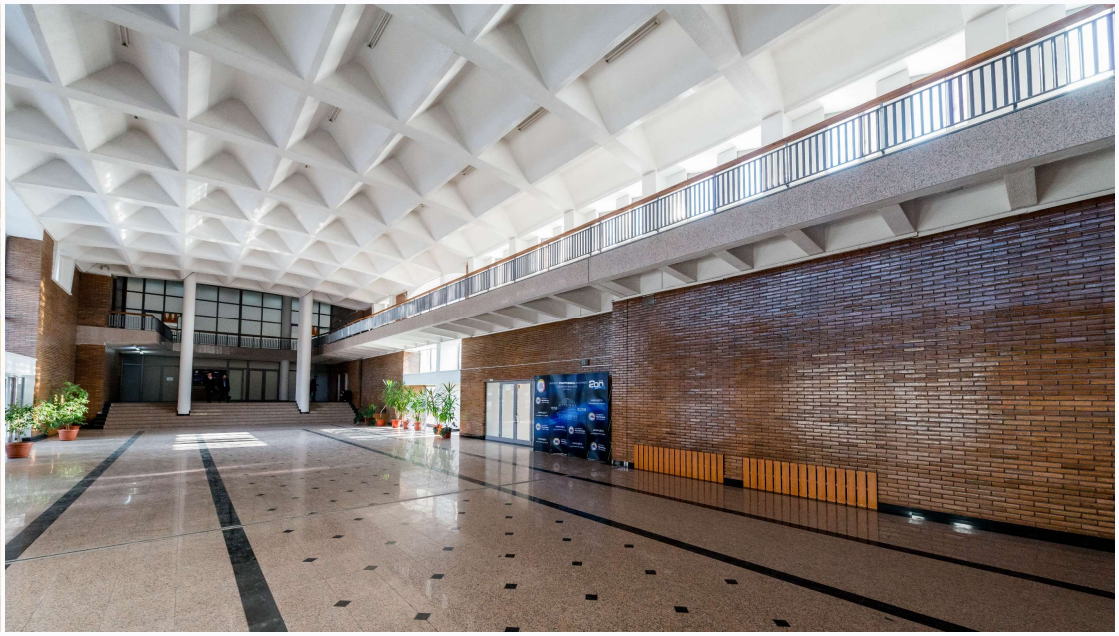


TV channels

Social media

Press

The UPB Event Hub



The central Rectorate Building

New trends in Bioengineering Education

Traditional Engineering Education

- Highly sequential, a pyramid of prerequisites
- Highly specialized within majors
- Little flexibility (few free electives)
- Stress scientific analysis rather than design and synthesis
- Too much technical content at the expense of a broader, liberal education

Traditional Undergraduate Curriculum

Passing Through Filters

Science
Mathematics
Humanities &
Social Sciences

I Freshman

Science
Mathematics
Eng. Science
H . & S. S.

II Sophomore

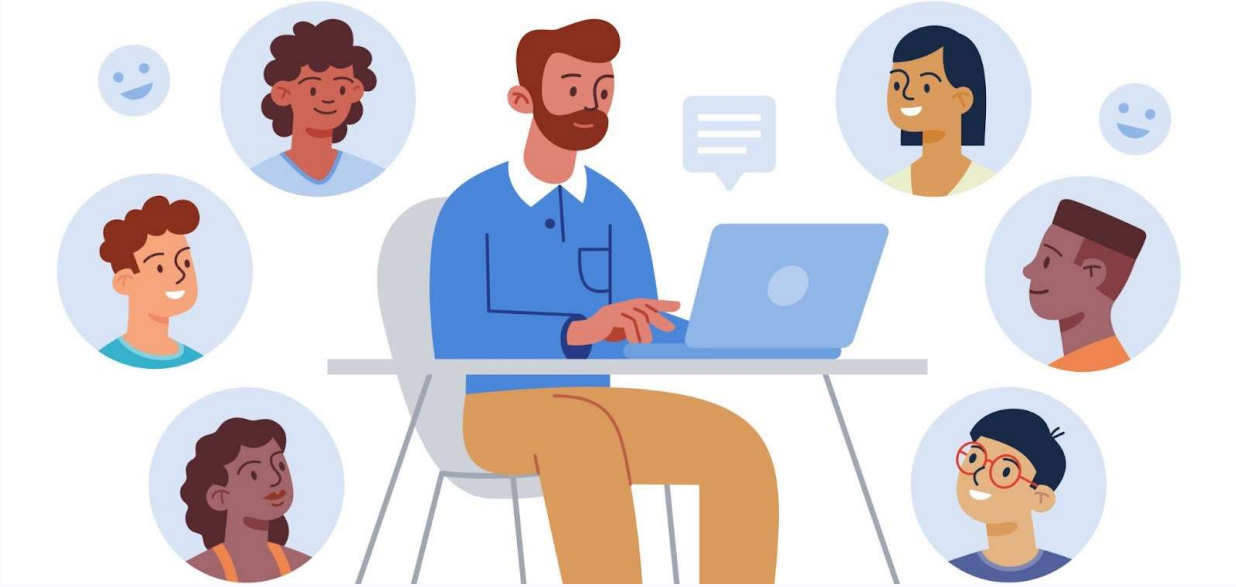
Eng. Science
Disciplinary Eng.
H . & S. S.

III Junior

Disciplinary Eng.
Design Project
H . & S. S.

IV Senior

What do employers want?



- Strong Technical Skills
- Problem-Solving and Analytical Thinking
- Strong Communication Skills
- Adaptability and Continuous Learning

Some Observations about Education

Peter Drucker: "We will redefine what it means to be an educated person. Traditionally an educated person was someone who had a prescribed stock of formal knowledge. Increasingly, an educated person will be someone who has learned how to learn, and who continues learning throughout his or her lifetime."

Ancient Chinese proverb:

- I hear, and I forget.
- I see, and I remember.
- I do, and I understand!

A 21st Century World

Information Explosion

Global Economy

Cognitive Revolution

International Competition

Diverse Workforce

Finite Resources

Defense Reinvestment

Shared Wealth

Environmental Sustainability

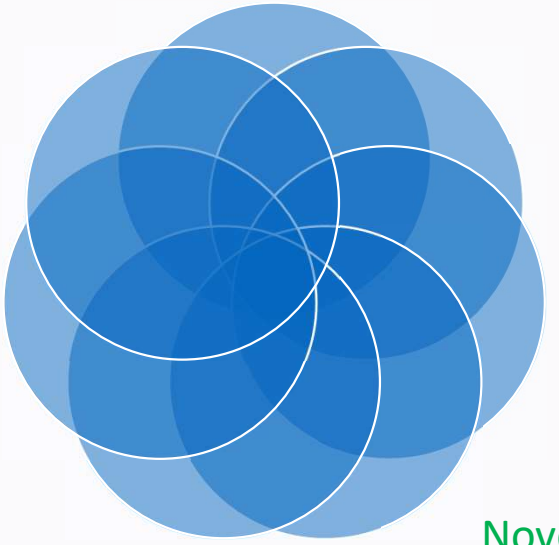
Demographic Shifts

The New Machines of tomorrow

Machine learning

AI-driven healthcare diagnostics and therapeutics

Internet of Things



Sustainable materials and energy systems

Autonomous and robotic systems

Smart grids, cities, and urban infrastructure

Novel materials design and manufacturing systems

New trends in Bioengineerin

Integration of Artificial Intelligence (AI) and Machine Learning (ML)

1. Curriculum Development

•**AI and ML Fundamentals**: Introduce fundamental courses on AI and ML, focusing on algorithms, data science, and their applications in biological systems. These courses could cover topics like supervised and unsupervised learning, neural networks, deep learning, and natural language processing (NLP).

•**Application-Based Learning**: Develop modules or courses that apply AI and ML specifically to bioengineering problems. This could include the use of AI in genetic engineering, drug discovery, tissue engineering, and biomedical imaging.

•**Interdisciplinary Approach**: Encourage an interdisciplinary curriculum that combines bioengineering with computer science, mathematics, and data science to provide a more holistic understanding of AI and ML applications in biological contexts.

2. Hands-On Projects and Laboratories

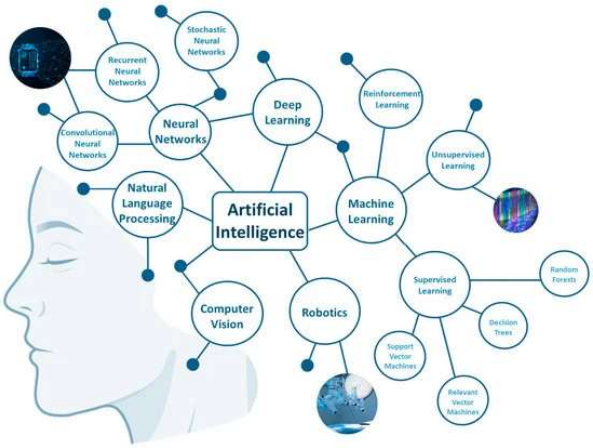
•**AI and ML in Laboratory Work**: Incorporate AI and ML into lab exercises where students can work with real-world datasets. For example, analyzing genomic data to identify patterns associated with diseases or using ML algorithms to predict the behavior of synthetic biological systems.

•**Capstone Projects**: Encourage students to undertake capstone projects that involve AI and ML. These projects could focus on areas like developing predictive models for patient outcomes, creating AI-based tools for bioinformatics, or designing intelligent systems for bio-manufacturing processes.

3. Use of AI Tools and Software

•**Data Analysis and Visualization**: Teach students how to use AI tools and software for data analysis and visualization in bioengineering. For example, using ML algorithms to interpret high-throughput biological data or employing AI for image analysis in biomedical imaging.

•**Simulation and Modeling**: Utilize AI for simulating complex biological systems and processes. This can help students understand dynamic interactions within biological systems, such as enzyme kinetics, cellular signaling pathways, or physiological responses to stimuli.



New trends in Bioengineerin

Precision Medicine and Genomic Engineering

1. Curriculum Development

- Develop core courses that introduce students to the principles of genomics, genetic variation, and personalized medicine. Topics could include DNA sequencing technologies, gene editing techniques (such as CRISPR), and the principles of pharmacogenomics.
- Cover applications in genetic therapy, agricultural biotechnology, and synthetic biology.
- Encourage an interdisciplinary curriculum combining bioengineering, molecular biology, genetics, computer science, and ethics.

2. Integration of Bioinformatics and Computational Tools

- Offer courses on bioinformatics tools and algorithms used for genomic data analysis.
- Train students to use computational models to predict individual responses to therapies based on genetic and molecular data, enhancing their understanding of personalized healthcare strategies.

3. Simulation and Modeling Virtual Simulations of Genetic Engineering:

- Utilize virtual labs and simulations to model genetic engineering processes, allowing students to experiment with gene editing techniques in a controlled environment.
- Train students to use computational tools to model genetic pathways and predict the impact of genetic modifications on cellular and organismal functions.

New trends in Bioengineerin

Biomaterials and Tissue Engineering

1. Interdisciplinary Learning:

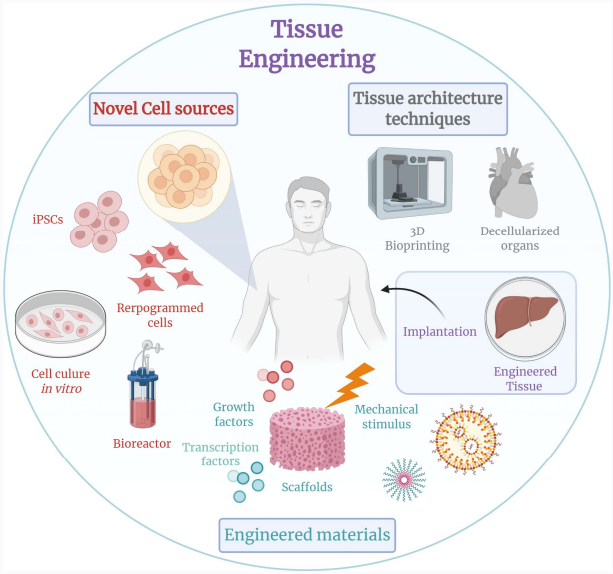
- Encourage an interdisciplinary approach by combining principles of materials science, mechanical engineering, biology, and medicine. This integration helps students understand the multi-faceted nature of biomaterials and tissue engineering, including the biological response to implanted materials and the mechanical requirements of engineered tissues.

2. Collaborative Projects:

- Facilitate interdisciplinary team projects where students from bioengineering, chemical engineering, and biology work together to solve complex problems in biomaterials and tissue engineering. This promotes collaboration and communication across different scientific domains.

3. Integration of Computational Modeling and Simulation

- Teach students to use computational tools to model the mechanical behavior, degradation, and biological interactions of biomaterials. This helps in predicting how materials will perform in vivo, optimizing material selection and design for specific applications.
- Include computational simulations in tissue engineering education to model cell-scaffold interactions, nutrient diffusion, and mechanical forces within engineered tissues. This helps students understand the complex dynamics involved in tissue growth and development.



New trends in Bioengineerin

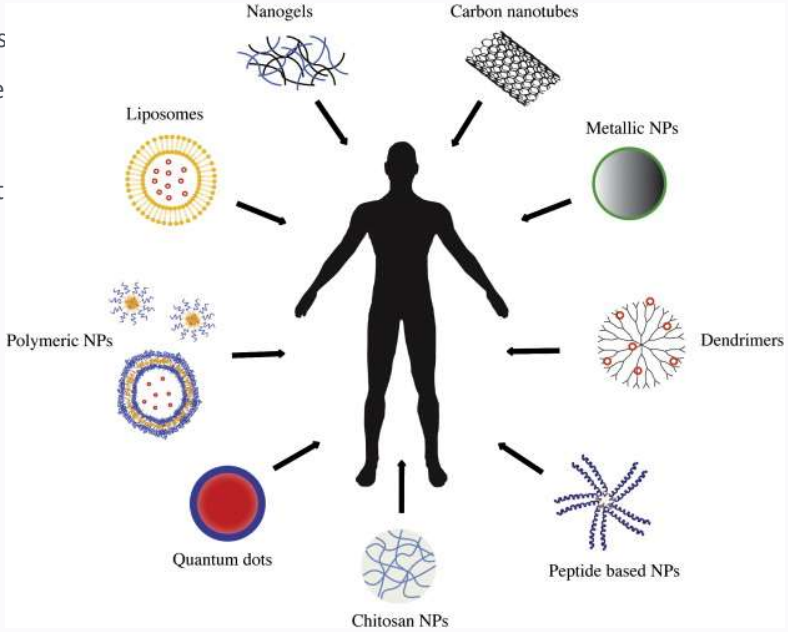
Nanotechnology in Medicine

1. Hands-On Laboratory Experience

- Develop lab modules focused on designing and testing nanoparticle-based drug delivery systems. Students can work on encapsulating drugs within nanoparticles, optimizing drug release profiles, and evaluating the efficacy of these systems in vitro using cell cultures.
- Include simulations that model the biodistribution, clearance, and targeting efficiency of nanoparticles in t body. These simulations help students understand the complexities of designing nanoparticles for specific medical applications, such as targeting tumor tissues or crossing the blood-brain barrier.

2. Ethics in Nanomedicine

Discuss the ethical implications of using nanotechnology in medicine, including concerns about patient safety, privacy issues related to nanoscale diagnostic tools, and the potential for unintended consequences of nanomaterial exposure. Address the societal impact of nanotechnology, including its potential to reduce healthcare costs and improve access to advanced treatments.

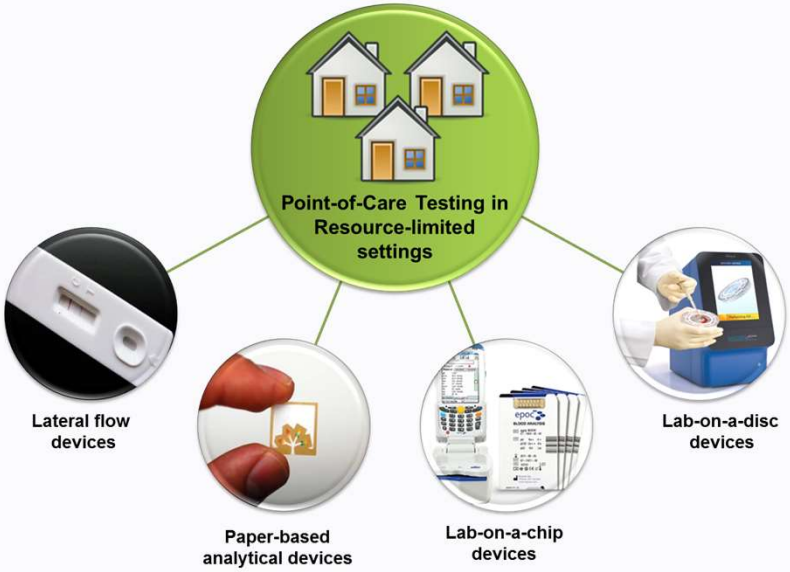


New trends in Bioengineerin

Point-of-Care Diagnostics

Hands-On Laboratory Experience

- Integrate laboratory courses where students can design and fabricate POC diagnostic devices. Labs could include prototyping microfluidic devices, creating biosensors using various transducers (optical, electrochemical, piezoelectric), and developing lab-on-a-chip systems.
- Develop lab modules focused on the testing and validation of POC diagnostic devices. Students can learn to evaluate device performance, including sensitivity, specificity, limit of detection, response time, and user-friendliness.
- Include lab experiences where students analyze real or simulated biological samples (e.g., blood, saliva, urine) using POC devices. This hands-on practice helps students understand the practical considerations and challenges in sample collection, preparation, and analysis at the point of care.



Advanced Polymer Materials Group

APMG includes 36 members specialized in the fields of chemistry, chemical engineering, medical engineering and physics

APMG members at 22nd Romanian International Conference on Chemical Engineering, Sinaia, Romania, September 7-9, 2022

Research topics

➢ ***Synthesis of nanocomposites for various applications***

- Different hybrid materials based on **epoxy / benzoxazines** reinforced with various nano-agents: ***modified montmorillonites, modified carbon nanotubes, polyhedral oligomeric silsesquioxanes, halloysites***;
- ***(Bio)materials for Tissue Engineering and Drug delivery***
- Design, synthesis and complex characterization of macromolecular scaffolds with tailored properties appropriate for specific biomedical needs;
- Hybrid dental nanomaterials with enhanced properties
- Polymeric biomaterials for biomedical applications in tissue engineering, regenerative and personalized medicine
- (Bio)functionalization of polymer substrates

➢ ***Computer aided molecular design of polymers and nanocomposites***

- Modelling and predicting of hybrid nanocomposites properties using computational models

APMG
Advanced Polymer Materials Group

www.apmg.upb.ro

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In the last 10 years

- We published more than 300 scientific articles and book chapters in prestigious WoS-indexed journals (according to Scopus, accessed 16/01/2023) accumulating more than 3900 citations;
- We managed more than 50 research projects in collaboration with national and international laboratories, as well as industrial partners accumulating a budget of over 20M euros;
- We published more than 15 national patents;
- We participated with more than 100 scientific papers presented at prestigious national and international conferences in the field of polymeric materials;

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Advanced Polymer Materials Group

Labs in 2 locations

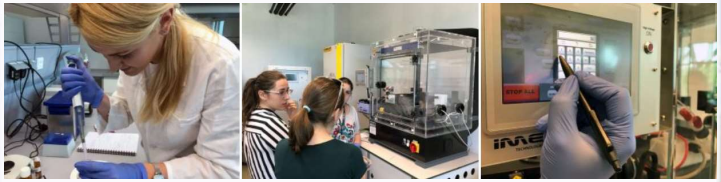
1. Polizu Campus

- Laboratory for Polymer nanocomposites / biomaterials synthesis
- Laboratory for Advanced Chromatographic and Spectroscopic analysis
- Laboratory for Thermal Characterization
- Laboratory for Mechanical Characterization
- Laboratory for Biological Investigation

2. Campus Research Institute

- Laboratory of advanced methods for polymers and nanomaterials processing
- Laboratory of Nanostructured Surfaces Engineering and Biomimetics
- Laboratory of intelligent systems for controlled release
- Complex Imagistic Analysis Laboratory

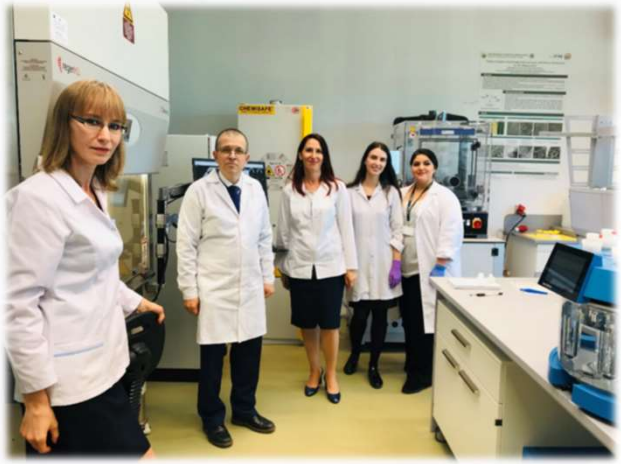
Faculty of Chemical Engineering and Biotehnology, UPB



Campus Research Institute, UPB

**"Innovative Technologies for Materials Quality Assurance in Health, Energy and Environmental –
Center for Innovative Manufacturing Solutions of Smart Biomaterials and Biomedical Surfaces (INOVABIOMED)"**

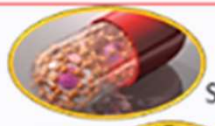
Nano-technologies I Smart materials I Smart biofabrication I Advanced control over properties I
Biomimetics I Surface engineering I Microfluidics I Bioresouces for functional materials I
Environmental impact I improved Health I Personalized medicine I Nanomedicine

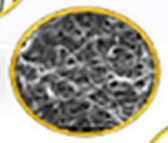


INOVABIOMED project management team

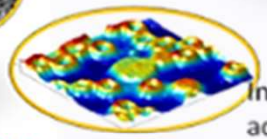
16 mil. Euro
Infrastructure
(2016-2020)


Bio-inspired controlled architectures

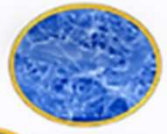

Smart drug delivery


Scaffolds for regenerative medicine


Smart nanoparticles


Innovative tools to characterize advanced nanostrctured materials


Nanostructured used to stimulate optimized cellular response


Controlled nanostructured surfaces and interfaces for nanomedicine

Controlled nanostructured surfaces and interfaces for nanomedicine


Controlled biomineralization on engineered advanced materials

INOVABIOMED

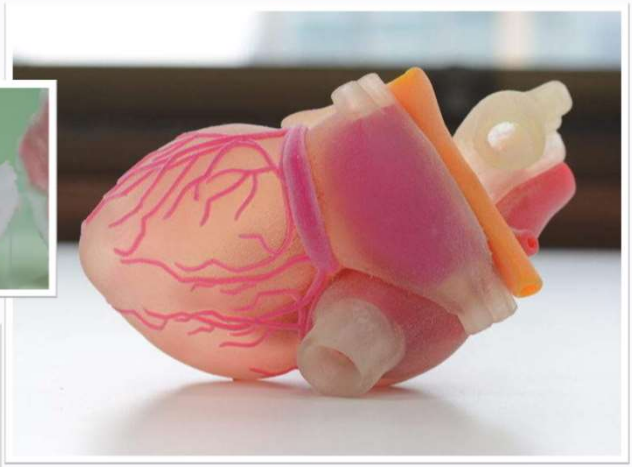
POC-A.1-A.1.1.1- F- 2015 – Large R&D Infrastructure, Project Type Investment Projects for Public R&D Institutions / Universities, ID P_36_611

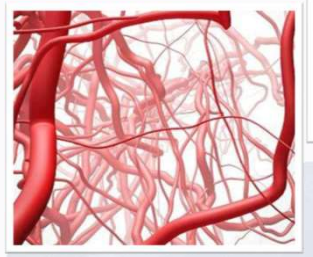
(Bio)fabrication for tissue engineering, personalized implants, surface engineering, bioactivation, implant analysis, advanced characterization

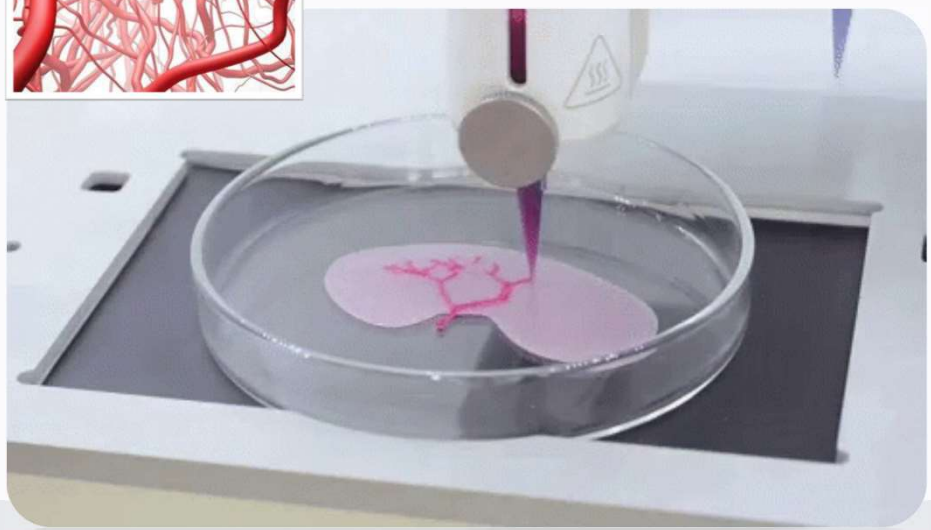
http://apmg.pub.ro/laboratories.html , https://erris.gov.ro/APMG---UPB

Artificial organs 3D Printing

Bioprinter for 3D cell printing
Campus Laboratory, 4th floor







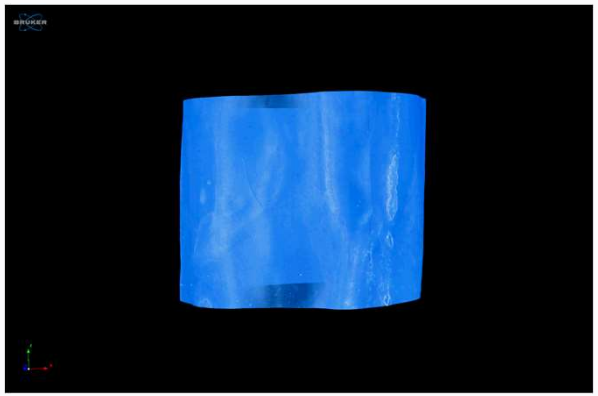
INOVABIOMED

Personalized implants

Material Characterization

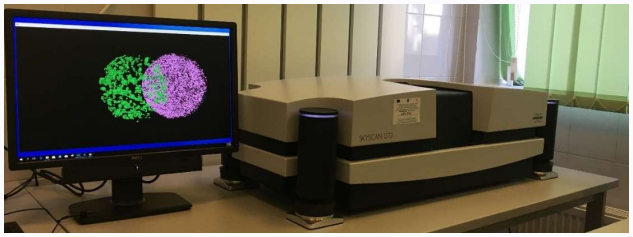
Samples view

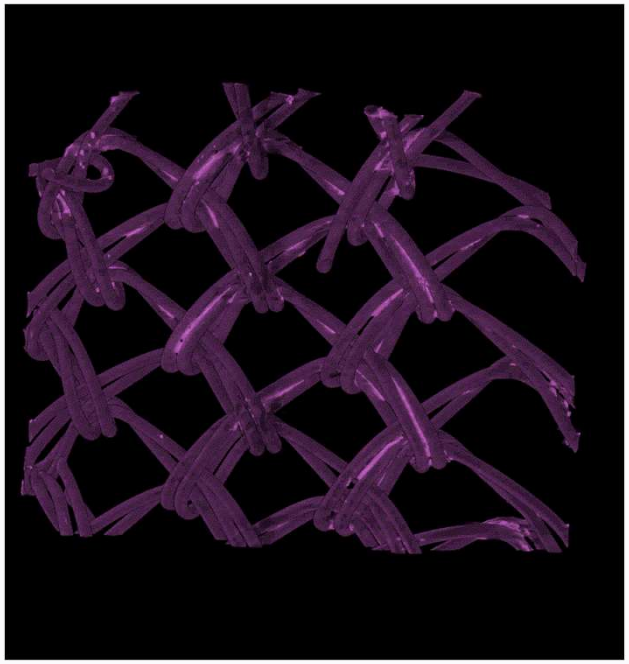
MicroCT



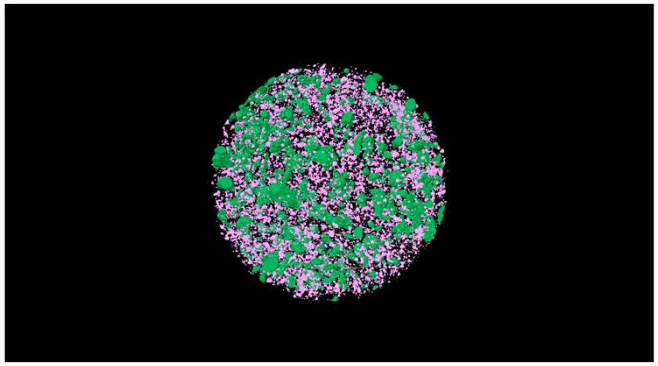
NanoCT

Nervous tissue





Biofunctionalized abdominal wall fixing scaffold

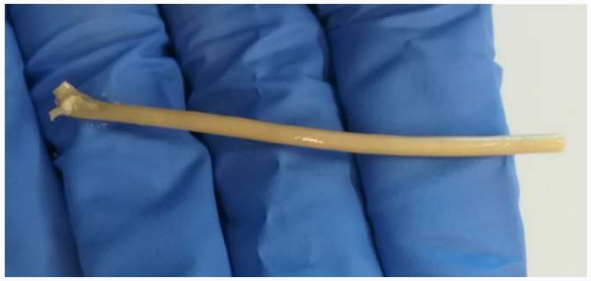


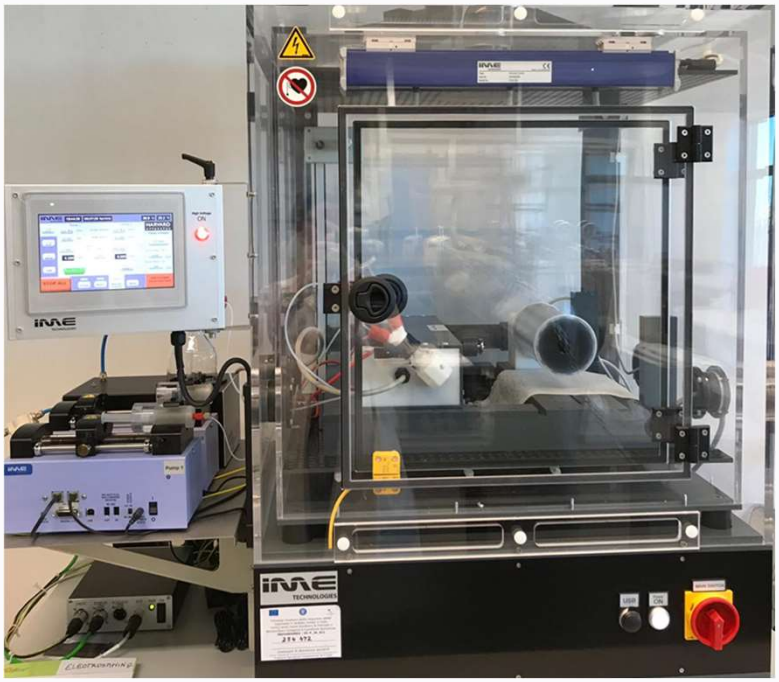
Orthopedic cement

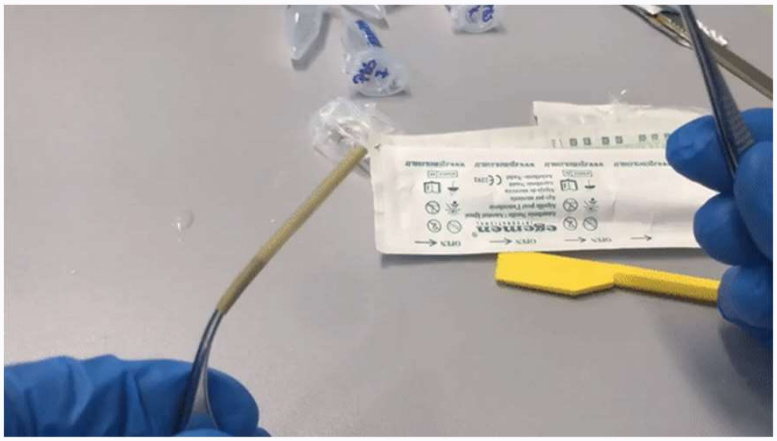
UNIUNEA EUROPEANĂ

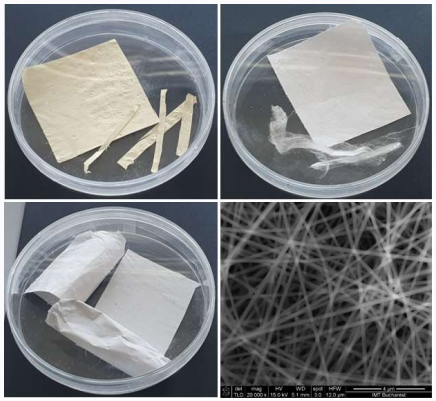
Instrumente Structurale 2014-2020

Electrospinning system for obtaining nerve conductors









Wound healing dressings based on fibers from natural polymers

Thank you!