

JAN EVANGELISTA PURKYNĚ
UNIVERSITY
IN ÚSTÍ NAD LABEM



**PROFILE AREAS OF SCIENTIFIC, RESEARCH,
DEVELOPMENT, INNOVATIVE
AND ARTISTIC ACTIVITIES**

The creative activities of the Jan Evangelista Purkyně University in Ústí nad Labem (hereinafter as “JEPU”) are focused on the economic, humanities, natural, social, technical and health sciences with the current integral development of the artificial activities. The university workplaces systematically build cooperation with **industries and the public sphere**, strive to develop innovations, and **cooperate with public and non-profit organisations**. The University wants to continue promoting contacts, networking and cooperation within international research and creative activities, not only with research institutions and university workplaces along the north-west border of the Czech Republic in Germany and Poland, but also with other places in Europe as well as outside Europe.

To promote inter-disciplinary cooperation and **creative team profiling at JEPU**, there are integrated competence teams operating in the following general areas:

- **Materials and technologies for the environment and quality of life (MATEQ)**
- **Smart City — Smart Region — Smart Community (SMART)**

MATEQ

Materials and technologies
for the environment and quality of life

The Jan Evangelista Purkyně University in Ústí nad Labem has built an inter-disciplinary thematic area with focus on materials and technologies applicable in the protection of the environment and in industry. The research focus utilises the current know-how of the excellent teams at the JEPU in the fields of chemicals and physiochemical methods of the preparation of advanced materials and nanomaterials for a broad range of applications in cooperation with partners in the region and partners at national and international level. The academic staff and students of several faculties of the JEPU are involved in this research area - Faculty of Social and Economic Studies, Faculty of Mechanical Engineering, Faculty of Health Studies, Faculty of Environment and Faculty of Science.

Within the scope of the strategic plan of the JEPU, we are developing the following areas:

- **For environmental protection**, research in chemical sensors and bio-sensors that are applicable in the detection of pollutants in an aqua and gaseous environment, nanomaterials for capture and degradation of pollutants and innovative sanitation procedures is in progress.
- In the area of **biomedicine nanomaterials**, the development and testing of nano-structured materials for new medicinal forms, nano-fibre materials for covering wounds and tissue engineering and bio-sensors for analysis of body fluids shall be done.
- In the area of **material engineering**, the research is focused on the modification of selected mechanical performances of progressive Al alloys with the objective to improve their functional characteristics. At the same time, intensive research is in progress that concerns the surface finishing of machine parts during the application of layers of nanomaterials to improve the durability and service life of the mechanical components.
- In the area of **progressive manufacturing technologies**, research focused on the optimisation of machining and forming processes is in progress in terms of minimisation of the manufacturing costs while simultaneously taking into consideration the environmental aspects of the manufacturing process.
- **Biomedicine applications** include the locomotion laboratory and procedures for improvement of life quality.
- In cooperation with the Faculty of Social and Economic Studies, Faculty of Mechanical Engineering and the Faculty of Environment, the JEPU teams devote attention to the **economic and environmental aspects of the technological processes in industry**.

Apart from strengthening the research base in the region, two other specific reasons also exist for the focus on the environmental issues and life quality – we base our judgement on the world renowned excellence of the given scientific teams in the given research field in the Faculty of Science and the Faculty of Environment and also reflect the needs of the region in the area of the environment and life quality. The significance of this research topic is also anchored in the Regional Innovation Strategy of the Ústí Region.

The inter-faculty team focused on the application of nano technologies was included in 2015 on the Travel map of European research infrastructures within the scope of the consortium of six research institutions under the leadership of The J. Heyrovský Institute of Physical Chemistry of the Czech Academy of Sciences under the name **NanoEnviCz**. Focus on applications that benefit the environment is based on the reflection of the situation in the environmental area in the Ústí Region. The university's **MATEQ** research base may be used not only by research organisations in the region, but also industrial partners and state administration authorities (Health Institute, Masaryk Hospital and other institutions).

Based on long-term cooperation in the field of environmental protection, the Centre for Advanced Organic Analyses (**CADORAN**) was founded in 2015 as a joint centre of University of J. E. Purkyně and the Health Institute with seat in Ústí nad Labem. The centre's objective is to concentrate material and professional capacities for improvement of the quality of environmental research and thus contribute to the improvement of the environment in the Northern Bohemian Region. The centre mainly benefits from the long-term experience of the staff of both institutions and thanks to the top-class equipment, it is capable of coping with the demanding problems associated with the emission of chemical substances to the environment and the consequences of these substances on the natural systems and human health. Already from its establishment, this centre is in close contact with significant healthcare and environmental laboratories in the Czech Republic.

In the field of material engineering and manufacturing technologies, teams with adequate capacity are ready at JEPU, which are associated under the **Ústí Materials Centre** and the **JEPU Science Technology Park**. Its main activity is focused on research in the field of progressive materials and technologies, development and analytical activities for partners from the entire spectrum of industry (manufacturing, processing, energy engineering, etc.).

Currently, the following research projects are running within the framework of the university consortium of faculties associated under the MATEQ:

UniQsurf

The project is focused on pre-application research and development of functional surfaces and hybrid materials for application in biomedicine, bioanalytical methods, catalysis and sorption processes. The project addresses the development of micro-equipment for testing medicines in 3D cell cultures, development of bioadhesive and antiadhesive surfaces and new hybrid materials for organocatalysis, separating processes and sequestration of gases.

Provider: EU, MEYS. Project Number: CZ.02.1.01/0.0/0.0/17_048/0007411.

Implementation period: 2018–2022, budget: € 3.5 million.

Guarantor: Jan Malý, MSc., Ph.D., Faculty of Science.

NANOTECH ITI II.

The project addresses development and research in the field of new nano and micro coats on the surface of selected metallic materials. The main aspect of the project is research in new advanced surface finishes and modifications of material surfaces for the purpose of improving selected mechanical (for instance, hardness, resistance to wear), chemical (for instance, corrosion resistance) and physical (for instance, thermal stability, thermal conductivity) performances.

Provider: EU, MEYS. Project Number: CZ.02.1.01/0.0/0.0/18_069/0010045.

Implementation period: 2019–2022, budget: € 2.2 million.

Guarantor: Prof. Štefan Michna, Eng. MSc, PhD., Faculty of Mechanical Engineering.

CACTU

The major objective of the CACTU strategic project is to establish a partnership with a significant subject from the application sector (UNIPETROL RPA) and complete the building of the open research infrastructure at the joint centres of JEPU, UniCRE and UNIPETROL RPA (the 3U Consortium), which in the field of chemical and related technologies guarantees long-term inter-sectoral research cooperation with the application sector that is focused on research in the chemical processes of the transformation of raw material resources in the region into the so-called green chemicals.

Provider: EU, MEYS. Project Number: CZ.02.1.01/0.0/0.0/17_049/0008397.

Implementation period: 2018–2022, budget: € 1.55 million.

Guarantor: Assoc. Prof. Dr. Pavel Kuráň, MSc., Faculty of the Environment.



The strategic project of JEPU for the new programme reason 2021+. This project is focused on nanomaterials and technologies for environment, biomaterials and their applications, renewable resources, hydrogen technologies and applications, electromobility, chemical processes for regional resources transformation and computer design of nanostructures (nanomaterials).

Provider: (preparation).

Implementation period: 2021+. Budget: € 60 mil.

Guarantor:

Smart City – Smart Region – Smart Community

The University of J. E. Purkyně in Ústí nad Labem is developing the interdisciplinary topic SMART (Smart City – Smart Region – Smart Community) as a long-term inter-faculty programme with focus on the social challenges in the context of the development of the municipalities and cities, regions and society. The major factors affecting the quality of life and the competitiveness of the economy are functional public administration, quality public services, secure infrastructure and overall environment of the cities and regions. A key role is played by culture and historical heritage protection. The global challenges of future development such as the ageing population, political conflicts, migration, global change and increasing competition in the national and international context require innovative approaches to their solution at the level of municipalities and regions. The Ústí Region reflects the importance of this complex topic and accentuates the issue of innovative public administration and public services in its RIS - Regional Innovation Strategy document. The competent teams at JEPU focus on future building of an integrated interdisciplinary plan, comprising partial key activities, which are mutually interlinked. The SMART topic interlinks the individual partial teams from all the eight faculties of the JEPU. It is being developed in cooperation with partners in the Czech Republic and abroad.

Major thematic areas of the activities of the SMART centre:

- **Management of the public administration and companies in the municipalities and regions** is a decisive factor in the environment for the citizens and their identification with the region. The JEPU team focuses on the partial topics like the tools and processes of the management of the municipalities and the regions, innovative public administration, reduction of the public administration costs, processes of democratisation and participation and the application of the Industry 4.0 strategy. A specific topic solved at the JEPU centres (based on the historical background of the region) is restructuralisation and transformation of the old industrial regions. Modern behavioural economics tools are applied in the individual analytical areas.
- **Public services and infrastructure in the municipalities and regions** constitute specific elements and processes that determine the environment for functioning of the cities, municipalities and regions. The major infrastructure components that are the subject matter of interest on the part of the JEPU team in cooperation with partners are transport, water, wastes, energy, buildings including heritage, but also the greenery in the form of the so-called green infrastructure and other elements such as ICT infrastructure for the development of e-government and support of decision-making as well as quick and quality management.
- **Innovation and enterprise** is a tool for growth of competitiveness and reduction of regional disparities. The activities in this area have significant application potential with objective to bring recommendations for mobilisation of the internal resources of the region's sustainable growth. The JEPU team focuses on support for the development of creativity, innovativeness and enterprise as well as support for and popularisation of technological and social innovations across the branches.
- **Nature, water and the landscape** in terms of historical development, global trends, but also future needs for permanently sustainable development ranks among the other SMART pillars. They thus naturally build on the professional competences developed, for instance, within the CADORAN and many projects of the Faculty of Environment, Faculty of Social and Economic Studies, Faculty of Science and other JEPU centres. The current research topics include water and floods in the landscape.
- The **social and economic problems of the society** rank among the long-term strong research and application topics at JEPU, also in the context of the long-term development and problems of the Ústí

Region. Research in cooperation with the application partners brings new impulses, which may transform these challenges into new opportunities and the solutions may be inspiring also for other regions. The major partner centres in this issue at JEPU are the Faculty of Education, Faculty of Health Sciences, Faculty of Social and Economic Studies, Faculty of Arts and the Faculty of Art and Design. The specific topics that the JEPU teams handle include social exclusion and inclusion, ageing of society, care for the citizens afflicted by social or health impairment, but also immigration and extremism.

The specific topics include the issues of education and selected aspects of the social integration of individuals with specific educational needs (health disabilities, health disadvantage and mainly social disadvantage, but also the giftedness of the pupils) and the possibility for development of inclusive education, just like the aspects of social integration and elimination of the action of socially pathological phenomena and risky behaviour of persons endangered by social exclusion. The Faculty of Arts focuses its research on the issue of urban development in the historical retrospective and a specific region, which was transformed to its modern semblance in the context of the intensive Czech-Saxony relationships, social migration and social instability.