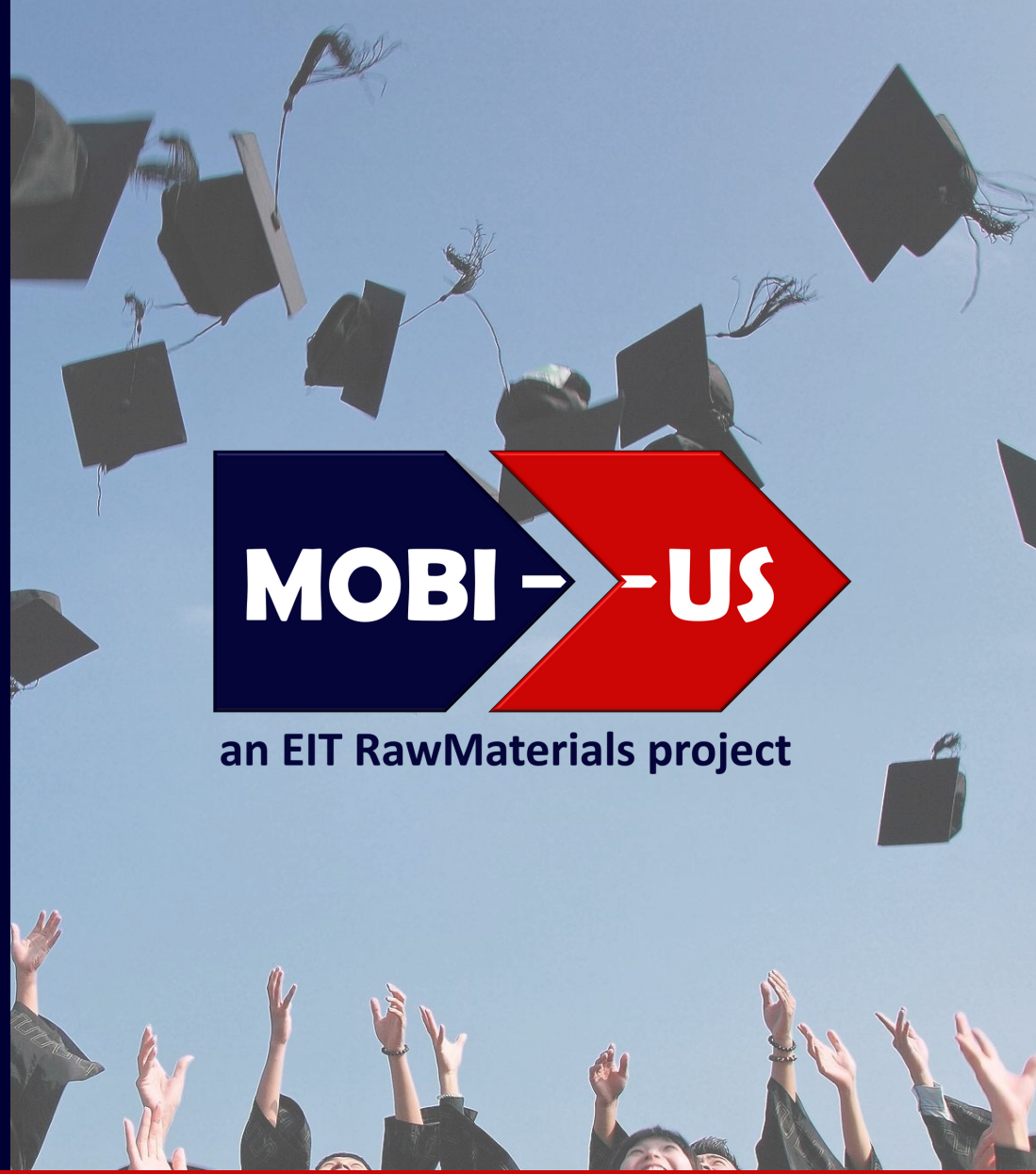
PROJECT BOOKLET

OCTOBER 2021

eit RawMaterials ACADEMY

Funded by the European Union



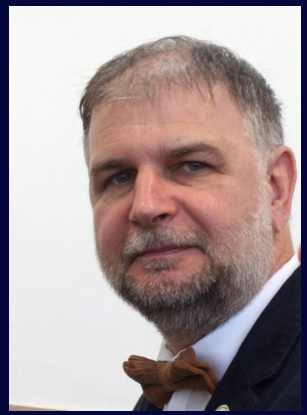
PROJECT OVERVIEW

MOBI-US is an EIT RawMaterials education project that has set up a pilot student mobility network between raw materials-related master programmes of the partner institutions in the ESEE region (East and Southeast Europe). With the help of the mentoring partners, the networking universities created mobility pathways for the students to develop their technical and soft skills in another university for one semester, as a complementary specialization.

WORDS FROM THE COORDINATOR

"A Master's studies is the period of specialisation and establishment of the professional network, and a one-semester structured mobility may strongly help both goals. Four ESEE universities with strong interest in the raw materials sector and with a long and respected history of training are cooperating in the MOBI-US project to strengthen their programmes and intensify the mobility of students within the region. The active help of the mentoring partners in this process is highly appreciated. Our vision is that the MOBI-US partnership will result in more tight, double-degree training options within the ESEE region."

Ferenc Mádai, University of Miskolc.



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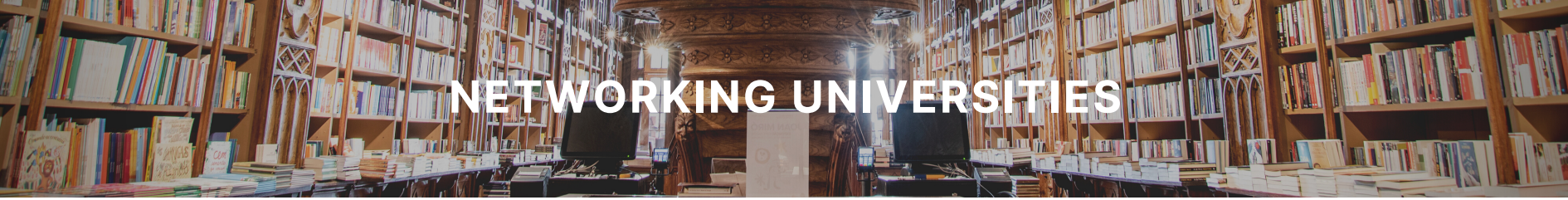


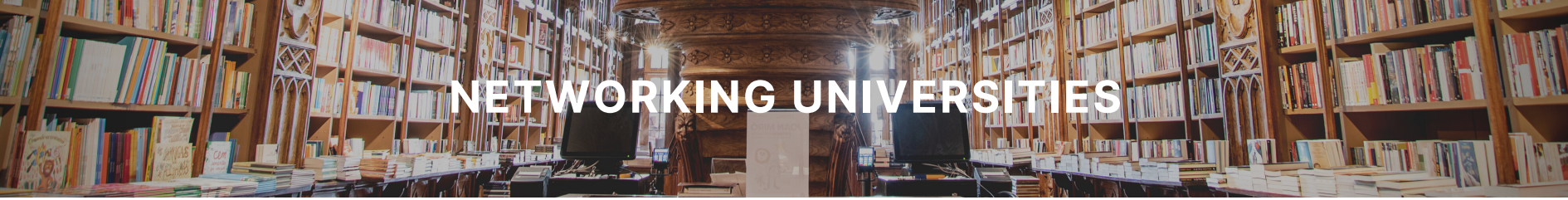
NETWORKING UNIVERSITIES

University of Miskolc

It is the largest higher educational institution in North Hungary. With its highly qualified academic staff, well-equipped laboratories, instruments and equipment, the University is a major centre of international scientific research and technical development. The Faculty of Earth Science and Engineering has more than 280 years of teaching and research experience in relation to mining and geology. The faculty has wide international cooperation and strong industrial partnerships. International teaching and research programmes are carried out in different fields of Earth sciences including mining, minerals processing, environmental engineering and geography.

University of Zagreb - Faculty RGNF

University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering (UNIZG-RGNF) organizes and conducts research and higher education activities. RGNF conducted the Strategy for Management of Mineral Resources in the Republic of Croatia, and it was a partner institution in the preparation of the Energy Strategy of the Republic of Croatia. The recent RGNF strategic documents foster the development of education and scientific research in order to support associated industry in the fields of: economic geology, exploration and environmental geochemistry, exploration geophysics, reserve estimation, environmental impact assessment, mining and geotechnical engineering, waste management, and legal issues related to mining cycle.



NETWORKING UNIVERSITIES

AGH University of Science and Technology

The AGH University of Science and Technology in Krakow is a modern state university whose priority is the accomplishment of tasks and projects related to education, scientific research and innovations. The Faculty of Civil Engineering & Resource Management (Faculty of Mining and Geoengineering until 2021; Faculty of Mining until 2002) is the oldest faculty of the university, with the mission to educate engineers and conduct research at the highest level in line with the current and future needs of the economy and modern civilization. The Faculty of Geology, Geophysics and Environmental Protection has the most environmental profile among the technical faculties of AGH. It is the only faculty in Poland that educates geology students to become specialists in applied geology, geophysics and computer science; and offers university-type of education, including the environmental aspects of geological sciences and tourism.

Wroclaw University of Science and Technology

Wroclaw University of Science and Technology is one of the most respected and highest ranking Polish Universities of Technology. The Faculty of Geoengineering, Mining and Geology is one of the sixteen faculties, which placed 1st (2017) and 3rd (2018) in the national ranking of mining engineering programmes. The field of study Mining and Geology has received the national accreditation. Master and bachelor programs are offered also in the field of study of Geodesy and Cartography. Among Polish students the option of international mobility is highly appreciated, therefore one of the strategic aims of the Faculty is increasing the internationalization of studies.

Earth Science Engineering MSc

The aim of the programme is to train geologists and geophysical engineers who have the knowledge of geology, geophysics and geoinformatics; with the necessary skills for the prospection and exploration of geological structures and mineral resources, the assessment of mineral resources and reserves, to conduct environmental geological surveys and delineate environmental pollution. Geological and geophysical engineers from this programme can plan, manage and operate these tasks, as well as develop new methods. Fundamentals of physical, mathematical and economic knowledge is also included in the training to create the background for a problem-oriented engineering approach. Having acquired a high level of practical and theoretical knowledge, the graduates are suitable to perform and manage prospecting and exploration tasks in the field, as well as to become involved in scientific research.

Environmental Engineering MSc

Geotechnology and environmental remediation are two issues important for the sustainable and safe mining operations. The programme is aimed to provide advanced knowledge for environmental engineers in ecology, engineering, economics and management, who are able to identify and assess existing or potential environmental hazards, to prevent environmental damage and reduce their impact, and to manage remediation projects. They should develop and use appropriate technological solutions to prevent environmental pollution. Environmental engineering MSc in the University of Miskolc is operated at the Faculty of Earth Science and Engineering, and it is reflecting in its profile: one of the two specialisations focuses on remediation of contaminants at the surface and near-surface environments; while the second one has a waste management and recycling character. Graduated environmental engineers can continue their studies at PhD level.

Mining and Geotechnical Engineering MSc

The aim of this program is to train engineers with up-to-date knowledge in natural sciences, engineering, economics, and management, building on their bachelor level studies. In addition, the Mining and Geotechnical Engineering MSc produces graduates who are capable of identifying and handling challenges related to geology, geotechnical engineering, as well as technical and economic. In addition, it prepares students with knowledge on risk remediation in surface and underground mining activities, specially near-surface earthworks, and the construction of mining-related underground areas and tunnels.

Mining Engineering

1. Specialization in Mining Engineering
2. Specialization in Geotechnical Engineering

The aim of the programme is to educate students for all tasks related to the research of soil and rock mass properties; the planning, carrying out, and monitoring the excavation during the exploitation of mineral resources or construction of infrastructure facilities, as well as during the exploration and exploitation of mineral resources. This study programme expands fundamental knowledge in the areas of technical and natural sciences, and qualifies students to apply this knowledge in developing their ability to create ideas in solving new or unknown situations in the professional and in the wider - interdisciplinary - context. The study programme relies to a great extent on laboratory work, fieldwork, and summer training.

Graduate study programme in Geology – Geology of Mineral Resources and Geophysical Explorations subprogramme

The aim of the programme is to train students who will, upon completion, be able to perform tasks as part of the reached level of qualification, which is applying the gained knowledge in the expert and professional environments. Graduates will have the ability to solve simple and complicated problems as a geologist in the field of Geology of Mineral Resources and Geophysical Exploration, and also in an interdisciplinary context. They will be prepared to find and assess mineral and energetic raw materials deposits, prepare reports, and conduct studies and projects about mineral resources by assessing the characteristics and behavior of these raw materials in the industrial processes, estimation of its volume, and interpretation of geological, geophysical and geochemical data. This education program will provide a solid background on fundamental and applied occupational research, and a basic starting point for further scientific research development. Upon completion, graduates will be prepared to continue their studies at doctoral level.

EDUCATION PROGRAMS
AGH University of Science and Technology

Mining engineering MSc

The aim of the program is to broaden the knowledge and improve skills in the field of Mining Engineering. At the core of Mining Engineering are the issues of earth sciences, geology, modern physics, mechanics – the impact of mining works on the surface, geomechanics, surveying, deposit geology, mining machinery exploitation, deposit mining technology of various raw materials, shooting technology, drainage, stacking, liquidation mines; as well as economics and modern methods of managing a mining enterprise, including safety in such a unique work environment.

Economic geology MSc

The graduates have a broad knowledge in prospecting, documenting and evaluating mineral deposits. They are able to plan and perform an exploration program depending on genetic type of deposit and searched elements, as well as controlling processes of excavation of ore horizon. The knowledge acquired from the studies allows to choose optimal field and laboratory assay methods that are necessary for both prospecting and documentation reports. Our graduates know how to perform a field work and are familiar with the methodology involved in different sampling methods. Theory knowledge is not all, students also take part in obligatory field works and diploma field works.

Applied geophysics MSc

The student of the geophysical specialization “Applied geophysics” is a specialist in the field of broadly understood applied geophysics. He/she has knowledge in the use of geophysical methods in geology, mining, mineral exploration, geotechnics, environmental engineering and protection, subsurface and surface construction, archeology, and related fields. He/she is able to use the latest geophysical techniques and software to process and interpret the results of laboratory and field tests. In addition, the student acquires expanded knowledge that prepares him/her for independent design and documentation of geophysical work; as well as to design, conduct and interpret the results of both surface, underground and borehole geophysical surveys. The graduates have the ability to comprehensively interpret geophysical surveys based on the acquired knowledge on geology, mining, geomechanics, geotechnics, and more. They also learn the economic aspects of applying geophysical methods and how to raise funds for their implementation.

Mining engineering MSc

The development of European economies depends on natural resources, abilities to use them, and required adequate technical staff. The assumed educational effects meet economy practice needs in the field of mineral resources management, as well as technologies and techniques of their exploration. In addition, they comprise prospecting, mining, processing, industrial land reclamation and development, and enterprises (especially mines) management. It is supported by information, environment and people management, with the use of state-of-the-art information and marketing techniques and technologies. Such integration of economy needs and assumed educational effects makes the labor market favorable for the Faculty graduates.

Geotechnical and Environmental Engineering MSc

Public acceptance of the mining industry is globally low due to bad environmental legacies in the past. The proper management of mining waste requires specialists trained in environmental and geotechnical issues of the mining industry. On the other side, computer-aided modelling of deposits and mining processes, and the more intensive need to utilize the underground space, opened the demand for specialists in geotechnics and rock mechanics. Environmental and geotechnical issues for the European extractive industry remain actual, especially for the Eastern and South Eastern European (ESEE) region. On the other hand, the legacy of the extensive ore mining activities in the past needs site remediation and safety measures all over the ESEE countries.

Geomatics for Mineral Resource Management MSc

Geomatics for Mineral Resource Management focuses on the process of resource modelling and mine management. Students will be taught in a variety of subjects related to the field of mining and mineral resources. This includes financial, environmental, political as well as the legal aspects of national and international mining projects. In addition to the standard courses taught by staff from partner universities and industry experts, massive open online courses (MOOC's) are offered to the students. Thus, the graduates of this master program will be prepared to work in any international and multicultural environment in which advanced and state of the art interdisciplinary knowledge of mining and geology, computer aided design, and geomatics are required.

MOBILITY PATHWAYS

#1 Geomatics / Environmental Geology, Geology

#2 Geology, Geomatics

#3 Applied geophysics, Earth Sciences engineering

#4 Earth Sciences engineering, Applied geophysics

#5 Environmental and Geotechnical Engineering

#6 Environmental and Geotechnical Engineering

#7 Environmental and Geotechnical Engineering

#8 Mining Engineering

#9 Mining Engineering

#10 Mining and geotechnical engineering

#11 Mining and geotechnical engineering

#12 Mining engineering

#13 Mining engineering

PATHWAY #1

CONTACT: Prof. dr. sc. Stanko Ružičić (stanko.ruzicic@unizg.rgn.hr)

GEOMATICS/ ENVIRONMENTAL GEOLOGY, GEOLOGY

A: Geotechnical and Environmental Engineering specialisation

1st (summer) - [ECTS]		2nd (winter) - [ECTS]		3rd (summer) - [ECTS]	
Theory and practice in geomechanics	[6]	Applied geophysics 1.	[6]	Mineral processing systems	[3]
Computer Aided Geological Modelling and Geostatistics	[5]	Instrumental methods of analysis (elective)	[4]	Principles and application of InSAR and GIS in mining	[5]
Project management, appraisal and Risk Evaluation	[4]	Exploration geochemistry	[5]	Digital mine	[2]
Engineering Geophysics	[3]	Methods in sedimentary petrology (elective)	[3]	Free elective	[2]
Integrated analysis of deformations in geomechanical engineering	[5]	Environmental mineralogy	[5]	Diploma seminar	[2]
Occupational health and safety	[2]	Technical petrography 2	[6]	Foreign language	[2]
Environmental chemistry	[5]	*Statistics*	*[5]*	Master thesis	[14]
	[30]	Foreign language	[1]		[30]
			[30]		

PATHWAY #1

CONTACT: Prof. dr. sc. Stanko Ružičić (stanko.ruzicic@unizg.rgn.hr)

B: Geomatics specialisation

1st (summer) - [ECTS]		2nd (winter) - [ECTS]		3rd (summer) - [ECTS]	
Physics - the structure of matter	[2]	Applied geophysics 1.	[6]	Geoinformation project management	[2]
Foreign language	[2]	Instrumental methods of analysis (elective)	[4]	Selected topics in information technologies	[3]
Advanced numerical calculation methods	[4]	Exploration geochemistry	[5]	Distributed spatial databases	[3]
Advanced geospatial analysis	[5]	Methods in sedimentary petrology (elective)	[3]	Management of company development	[2]
Geostatistics	[5]	Environmental mineralogy	[5]	Free elective	[3]
Special measurements	[4]	Technical petrography 2	[6]	Diploma seminar + Master thesis	[15]
Selected topics in GNSS	[4]	*Statistics*	*[5]*		
GIS programming 1	[4]	Foreign language	[1]		
	[30]		[30]		[30]

PATHWAY #1

CONTACT: Prof. dr. sc. Stanko Ružičić (stanko.ruzicic@unizg.rgn.hr)

Study goals in the mobility semester

- **Applied Geophysics 1:** Introduction to surface geophysical research with practical application of methods in defining geological structure and terrain composition.

- **Instrumental methods of analysis (elective)**: Mastering basic knowledge in analytical methods and techniques that are applied in geosciences for determination of chemical and mineralogical composition, crystal structure, granulometry and morphological properties of minerals, rocks, recent sediments, and soil.

- **Exploration geochemistry**: Students will get acquainted with the theory and practice of exploration geochemistry, i.e., with usage of geochemical principles in finding geochemical anomaly caused by ore deposit. They will learn principles of primary and secondary dispersion, trace element geochemistry, sampling media, different chemical analyses of geological materials and geochemical data interpretation. In addition, students will develop their communication skills through oral presentation and report writing.

- **Methods in sedimentary petrology (elective)**: Introduction to and selective application of analytical methods in the investigation of lithified and non-lithified sediments and soils. Mastery of techniques and skills in investigation of sediments, sample preparation, quantitative and qualitative estimation of mineral composition, granulometry, and morphometrics. Mastery of techniques and skills in interpretation, classification and presentation of the results acquired by the methods of investigation of sediments.

- **Environmental mineralogy**: The major goal of this course is to make students acquainted with the basic knowledge about the role of mineralogy in various aspects of environment; e.g., importance of mineralogy in resolving specific problems in environment such as contamination, waste management, land use, remediation strategies, environmental impact analysis and risk assessment, preservation and restoration of cultural heritage.

- **Technical petrography 2**: Objectives of the course are to introduce students with: 1) exploration of stone deposits (natural stone and aggregate); 2) natural (building) stone and aggregate and their properties and usability.

- **Statistics**: Adoption of basic concepts from the area of probability and their application in building models for statistical analysis. Getting acquainted with basic statistical methods and acquiring skills for their application in technology and natural sciences.

PATHWAY #2

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

GEOLOGY, GEOMATICS

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Petroleum Geology	[6]	Theory and practice in geomechanics	[6]	Subsurface Mapping	[6]	Regional Geology	[3]
Industrial Mineral Deposits	[6]	Computer Aided Geological Modelling and Geostatistics	[5]	Clay Mineralogy	[5]	Master Thesis	[25]
Sedimentology	[7]	Project management, appraisal and Risk Evaluation	[4]	Instrumental Methods of Analysis	[4]	Optional course	*[2]*
Analysis of Mineral Parageneses	[5]	Engineering Geophysics	[3]	3 Optional courses	[15]	*Regional Petroleum Geology*	*[2]*
2 Optional courses	[6]	Integrated analysis of deformations in geomechanical engineering	[5]	*Seismic and Sequence Stratigraphy*	*[5]*	*Geology of Croatia*	[5]
Physics of Reservoir Rocks and Fluids	*[3]*	Occupational health and safety	[2]	*Environmental Geochemistry*	*[5]*		
Seismotectonics	*[3]*	Environmental chemistry	[5]	*Environmental Mineralogy*	*[5]*		
Mining Law and Regulations	*[3]*			*Geoarchaeology*	*[5]*		
				Geoinformatics	*[5]*		
				Geostatistics	*[5]*		
	[30]		[30]		[30]		[30]

PATHWAY #2

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

Study goals in the mobility semester

- **Theory and practice in geomechanics**: Presentation of foundations of the Theory of Elasticity and its application in rock and soil mechanics. Introduction of fundamental concepts of rock and soil mechanics and their application in surface and underground mining.

- **Computer Aided Geological Modelling and Geostatistics**: Developing basic skills in computer modelling of 3D objects. Introduction to the principles of digital modelling of typical geological structures, and introduction to the methods of deposit parameters estimation and resources evaluation.

- **Project management, appraisal and Risk Evaluation**: The course combines two groups of topics: basics of mineral economics and financial management, and introduction to project management. Part A) Introducing the concept of time value of money and present the methods used to evaluate investment projects. Different techniques are illustrated by examples and case studies. The range of application as well as the advantages and disadvantages of each method are discussed. The issues of inflation and risk analysis are included. Part B) Introduction to project management basic concepts, methods and tools, as well as presentation of the issues of effective communication in project teams, group behavior and leadership.

- **Engineering Geophysics**: Introduction to the nature and subject matter of descriptive and applied geophysics, as well as the basic physical properties of rocks, phenomena and physical fields occurring in the geosphere. Students will be skilled at carrying out tests using the magnetometer method, and in processing and interpreting - at a basic level - results of geophysical field research.

- **Integrated analysis of deformations in geomechanical engineering**: Fundamental understanding of integrated analysis of deformations using the combination of monitoring and numerical modelling of deformations, which is essential for studying the processes occurring in engineering structures and in rock mass at the construction and post-construction stages. In addition, understanding the fully automated monitoring principles, data collection, and processing.

- **Occupational health and safety**: Introduction of the principles of occupational risk assessment in accordance to relevant standards. Presentation of the principles of occupational risk assessment and the determination of admissibility with the use of STER software and the RISC SCORE method.

- **Environmental chemistry**: Physical and chemical properties of water; chemical composition of natural waters and their contamination, water classification and water quality standards; physical and chemical processes that influence the content of the trace compounds in the air; methods of mathematical description of the temporal and special variability of substances concentration in the air; types of waste, the methods for determination of physical and chemical properties of the waste and the theoretical ways for their treatment.

PATHWAY #3

CONTACT: Dr. Ferenc Mádai (askmf@uni-miskolc.hu)

APPLIED GEOPHYSICS, EARTH SCIENCES ENGINEERING

1st (summer) - [ECTS]

Geoelectrical methods in structural deposit research	[5]
Modelling in geophysics	[5]
Application of Python programming in Earth sciences	[3]
Diploma training	[2]
Processing seismic data	[5]
Structural imaging	[3]
Law in mining and geology	[2]
Advanced statistical methods	[5]

[30]

2nd (winter) - [ECTS]

In-field seismic techniques and interpretation	[4]
Geoelectric College	[4]
Introduction to petrophysics	[4]
Geophysical exploration methods 1.	[5]
Computer aided well-log analyses	[5]
Global and environmental geophysics	[2]
Seismic college	[4]
Intellectual property law	[2]

[30]

3rd (summer) - [ECTS]

Comprehensive interpretation of geophysical data	[3]
Elective modules block - Applied geophysics	[2]
Geophysical monitoring	
Reservoir geophysics	
Elective modules block - The subject of foreign language	[2]
Economic aspects of geophysical research	
Geological interpretation of geophysical measurement	
Diploma seminar	[1]
MSc Thesis	[20]

[28]

PATHWAY #3

CONTACT: Dr. Ferenc Mádai (askmf@uni-miskolc.hu)

Study goals in the mobility semester

- **In-field seismic techniques and interpretation**: Advanced geophysical methods are illustrated in relation to the application of reservoir geophysics to field development and reservoir management: 3D/4D seismic, share waves and 3 component (3-C) data recording and data processing, 3D visualization, amplitude studies, AVO, and elastic inversion. The petroleum production significance associated with each seismic data set evaluated is emphasized.

- **Geoelectric College**: System of electrical and electromagnetic geophysical methods. Physical basics of direct current (DC) geoelectric methods. Solution of the Laplace equation in layered homogeneous isotropic half space. The geological information content and calculation of the kernel function. Hankel and the Inverse Hankel transformation. Physical basics of alternating current (AC) electromagnetic methods. Derivation of telegraph and wave equations. Information content of the wave number. Wavelength, penetration depth and propagation speed of electromagnetic waves. Characterization of dielectric, lossy and good conducting media. The zones formed around the electric and magnetic dipoles and the phase surfaces of the electromagnetic fields in the various zones. Electromagnetic field calculation of the horizontal electric dipole source in inhomogeneous anisotropic media. Electromagnetic field calculation of the vertical magnetic dipole source in inhomogeneous anisotropic media. Presentation of reports.

- **Introduction to petrophysics**: The topic provides rock physical basis for petroleum applications and the theory and practice of wireline logging measurements.

- **Geophysical exploration methods 1**.: Understanding the surface geophysical methods and the geophysical methods used in boreholes, to enable students to design and execute geophysical research and evaluate data.

- **Computer aided well-log analyses**: Introduction to the computer-aided management, visualization, processing and analysis of data coming from well logging operations applied in hydrocarbon exploration.

- **Global and environmental geophysics**: Training global environmental geophysics to a level that graduated engineers can begin to work in the field of general geophysics and maintain communication with colleagues working as experts in the field of global environmental geophysics.

- **Seismic college**: Summarization of seismic data acquisition, data processing and interpretation methods. Applications and uses of seismic methods for raw material exploration. New seismic technologies and methods.

- **Intellectual property law**: The purpose of subject is to acquaint the students with the forms of intellectual property law.

PATHWAY #4

CONTACT: PhD. Eng. Anna Kwietniak (akwt@agh.edu.pl)

EARTH SCIENCES ENGINEERING, APPLIED GEOPHYSICS

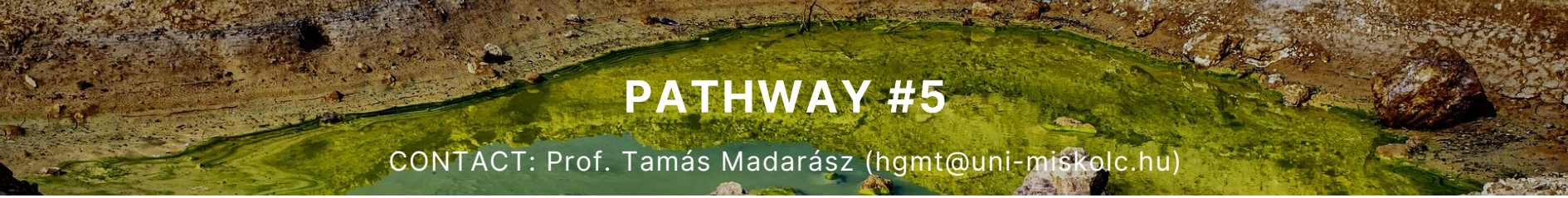
1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Numerical methods and optimization	[2]	Structural geology	[4]	Engineering sesimic / Engineering geoelectric	[4]	Strategic Management	[2]
Engineering physics	[4]	Mineral deposits	[4]	Potential methods	[5]	Safety techniques and labor safety	[2]
Physical geology	[4]	Engineering geology and hydrogeology	[4]	Processing and interpretation of well-logging data	[5]	Diploma thesis consultation 2.	[24]
Mineralogy and geochemistry	[4]	Analytical technics in mineralogy and petrology	[2]	Geophysical analyses in environmental protection	[2]	Quality management	[2]
Geodesy, spatial informatics	[4]	Geophysical measurements	[4]	Legal protection of intellectual property	[2]		
Computer science for engineers	[2]	Engineering and environmental geophysics	[4]	Computer modelling	[4]		
Geophysical exploration methods I.	[4]	Engineering physics II.	[2]	Prospecting and mineral exploration	[4]		
Data and information processing	[4]	Geophysical inversion	[2]	Thesis consultation (online)	[6]		
Graduate research seminar	[2]	Geophysical exploration methods II.	[4]				
	[30]		[30]		[32]		[30]

PATHWAY #4

CONTACT: PhD. Eng. Anna Kwietniak (akwt@agh.edu.pl)

Study goals in the mobility semester

- **Engineering seismic**: Applications of seismic methods in engineering problems – an individual practical project of investigations.
- **Engineering geoelectric:** Application of geoelectrical methods in engineering problems – practical project.
- **Potential methods**: Methods of qualitative and quantitative interpretation of potential fields data for recognition of the near-surface part of the rockmass and in the mining industry. Specialist methods used in the environmental magnetism research.
- **Processing and interpretation of well-logging data:** The module prepares for interpretation of well logs and results of laboratory measurement results on core samples in order to determine the reservoir parameters.
- **Geophysical analyses in environmental protection:** The module aims to familiarize students with the geophysical methods in connection with natural environment and their application in environmental protection.
- **Legal protection of intellectual property**: To acquaint the student with the principles and laws of intellectual property and patent rights.
- **Computer modelling**: This course provides advanced knowledge about building geological models.
- **Prospecting and mineral exploration:** This course provides advanced knowledge about methods, strategy and techniques used in mineral prospecting and exploration.



PATHWAY #5

CONTACT: Prof. Tamás Madarász (hgmt@uni-miskolc.hu)

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING

1st (summer) - [ECTS]

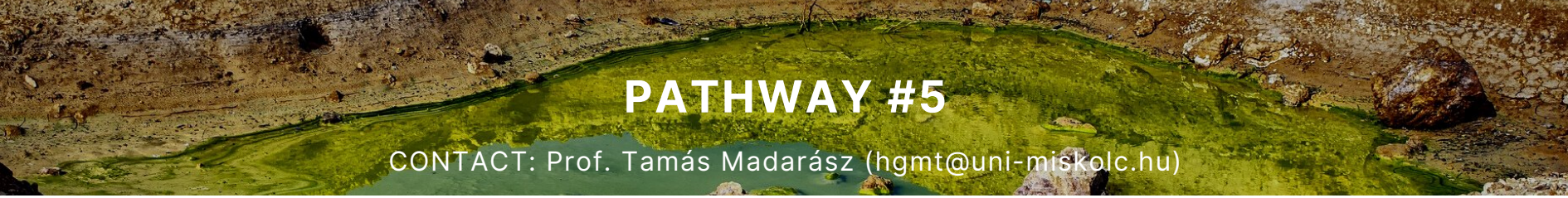
Theory and practice in geomechanics	[6]
Computer Aided Geological Modelling and Geostatistics	[5]
Project management, appraisal and Risk Evaluation	[4]
Engineering Geophysics	[3]
Integrated analysis of deformations in geomechanical engineering	[5]
Occupational health and safety	[2]
Excavation design in open pit mining	[5]
	[30]

2nd (winter) - [ECTS]

Methods of environmental assessment	[2]
Waste incineration and air quality protection	[4]
Water and wastewater treatment	[2]
Environmental geotechnics	[2]
Chemical technologies in environmental protection	[2]
Environmental risk assessment and remediation	[3]
Soil and water chemistry	[4]
Numerical methods and optimization	[2]
Quality management	[2]
Environmental geology	[4]
Foreign language	[3]
	[30]

3rd (summer) - [ECTS]

Mineral processing systems	[3]
Excavation design in open pit mining	[3]
Digital mine	[2]
Free elective	[3]
Diploma seminar	[2]
Foreign language	[2]
Master thesis	[15]
	[30]

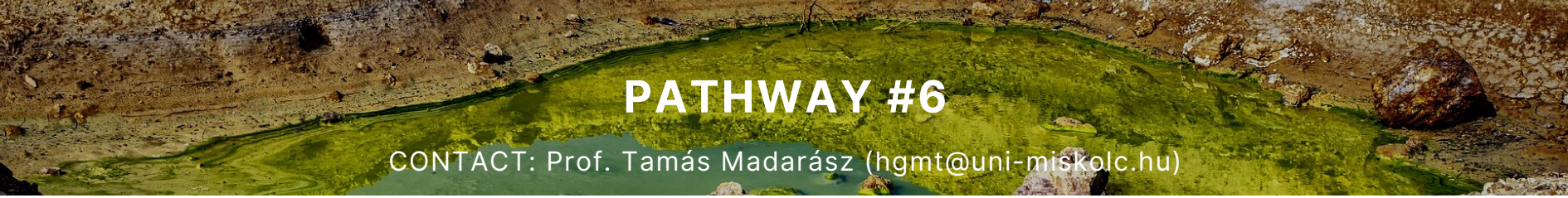


PATHWAY #5

CONTACT: Prof. Tamás Madarász (hgmt@uni-miskolc.hu)

Study goals in the mobility semester

- **Methods of environmental assessment**: Students awareness of the environmental assessment procedures, and the methods that can be used to make the study.
- **Waste incineration and air quality protection**: Fundamentals of air quality protection, and relevant applied knowledges about air quality control during different industrial activities that emit large quantities of air pollutants. Relevant background, especially to the Waste Management specialization.
- **Water and wastewater treatment**: The students will be familiar with the basic elements and concepts of modern water and waste water purification technology and processes. The students will be able to choose the right purification technology concerning environmental protection aspects.
- **Environmental geotechnics**: This is an applied course that introduces the most important geotechnical issues and tasks that appear during the design and operation of a landfill site. This is is an important applied course in the Remediation and Environmental Geotechnics specialisation.
- **Chemical technologies in environmental protection**: To introduce the chemical techniques on environmental pollution treatment, waste recycling and treatment, as well as on pollution control.
- **Environmental risk assessment and remediation**: Understanding risk assessment documentation and evaluating its correctness, working together with other field specialists in a risk assessor team. Introduction to remediation practices and their design, and the European practice of remediation planning and monitoring.
- **Soil and water chemistry**: Structure, physical and chemical properties of soils and water or aquatic media; highlight of the main intersection that exists between the phases of soils and the transformation of inorganic and organic materials in soils, the equilibriums exist in the aquatic phase.
- **Numerical methods and optimization**: Relation between engineering and mathematics; solution methods using both analytical and numerical techniques. Application of optimization techniques to various engineering problems.
- **Quality management**: Applying the approach of quality management, including managing or participating in related projects. Principles, concept and terminology of quality management and related corporate activities. Requirements of the ISO 9001 and specialties of project quality management.
- **Environmental geology**: Introduction of the effects of geological medium on the state and changes of the environment, and prepare them for revealing the geological background of environmental problems, as well as mitigating or minimizing these problems.

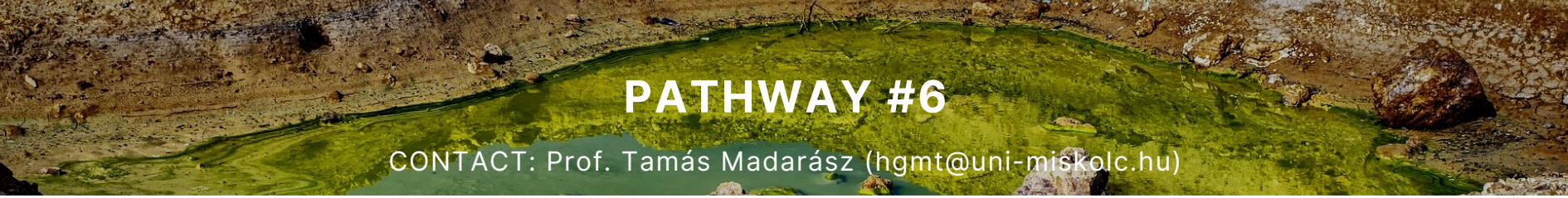


PATHWAY #6

CONTACT: Prof. Tamás Madarász (hgmt@uni-miskolc.hu)

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Statistics	[5]	Groundwater flow and contaminant transport modeling	[5]	Ground improvement	[5.5]	Projecting in mining	[7]
Soil mechanics II.	[5.5]	Geotechnical engineering	[4]	Underground chambers	[5.5]	Management	[2]
Applied geophysics I.	[6]	Contaminated site remediation	[4]	Earthworks (Geotechnical engineering)	[5.5]	Master thesis	[21]
Engineering geology	[5]	Environmental risk assessment and remediation	[3]	Tunneling	[5.5]		
2 Optional courses	[8.5]	Water quality protection	[3]	2 Optional courses	[8]		
Demolition of structures	*[3.5]*	Engineering and Environmental Geophysics	[4]	*Mining law and regulations*	*[3]*		
Measurement technology	*[3.5]*	Environmental economics	[2]	*Traffic routes*	*[3.5]*		
Numerical mathematics	*[3.5]*	Applied numerical methods (online course)	[5]	*Economics evaluation of projects*	*[4.5]*		
Clay mineralogy	*[5]*			*Ventillation of underground rooms and tunnels*	*[3.5]*		
Geoinformatics	*[5]*			*Geotechnical design*	*[3.5]*		
Chemistry for miners	*[5]*			*Soil dynamics*	*[4.5]*		
Renewable energy	*[4.5]*			*Underground waste dumps*	*[4.5]*		
				Testing and monitoring in geotechnics	*[5]*		
	[30]		[30]		[30]		[30]



PATHWAY #6

CONTACT: Prof. Tamás Madarász (hgmt@uni-miskolc.hu)

Study goals in the mobility semester

- **Groundwater flow and contaminant transport modeling:** Theoretical and practical aspects of the numerical methods widely used in the modern hydrogeology. The students will be able to use a worldwide known numerical environment. Using this environment the students will possess an ability to solve simple problems in the field of hydrodynamics and contaminant transport, and will later be able to solve more complex simulation problems.

- **Geotechnical engineering:** The students will be familiar with the basic concepts of geotechnical engineering, with the principles of designing and with the construction methods of different buildings and objects.

- **Contaminated site remediation:** Identify soil and groundwater contamination issues, contaminated site investigation, remediation design and implementation. Understanding the main elements of contaminated land management tools, e.g., problem formulation, risk based target value setting and risk assessment, site investigation, hydrodynamic and contaminant transport modeling, remediation action, and monitoring.

- **Environmental risk assessment and remediation:** Concept and framework of Environmental and Human Health Risk assessment and its relationship to contaminated land remediation. Understanding risk assessment documentation and evaluating its correctness, working together with other field specialists in a risk assessor team. Remediation practices and their design, and the European practice of remediation planning and monitoring.

- **Water quality protection**: The students will be familiar with the basic concepts, tasks and purposes of water quality protection. Contamination transport processes in surface water as well as in groundwater. Assessment and solving different water quality and contamination problems. The students will learn about the different tasks given by the European Water Framework in order to achieve the good status of water resources.

- **Engineering and Environmental Geophysics**: Introduction to shallow geophysical methods in solving geotechnical, engineering geological, hydrogeological and environmental problems. Overview of special geophysical methods and their developmental trends.

- **Environmental economics**: To show the development of environmental thinking and the reason of foundation of environmental economics as new scientific field of the economics science. To analyze the current status of space science. To highlight the relationship between environment and economy at macro and micro-economic context, and the applied tools and methods.

- **Applied numerical methods (online course)**: Understanding the relation between engineering and mathematics; comprehend important concept of solution methods using both analytical and numerical techniques when the problems can be formulated using differential equations, system of linear equations and system of nonlinear equations. In addition, students shall be able to apply the optimization techniques to various engineering problems.

PATHWAY #7

CONTACT: Prof. dr. sc. Biljana Kovačević-Zelić (biljana.kovacevic-zelic@rgn.hr)

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Analytical chemistry	[4]	Applied physical chemistry	[3]	Rock mechanics	[5]	Occupational health and safety	[2]
Environmental geology	[4]	Environmental economics	[2]	Soil mechanics 1	[4]	Elective course 2	[3]
Basics of environmental processing	[2]	Waste disposal, landfill operation and reclamation	[4]	Soil mechanics 2	[5]	Thesis work 2	[24]
Ecology and nature protection	[3]	Environmental and engineering geophysics	[4]	Geotechnical structures	[3]		
Soil and water chemistry	[4]	Water quality protection	[3]	Ground improvement	[5]		
Computer science for engineers	[2]	Groundwater flow and contaminant transport modelling	[5]	Underground structures	[5]		
Numerical methods and optimization	[2]	Geotechnical engineering	[4]	*Statistics*	*[5]*		
Chemical technologies in environmental protection	[2]	Contaminated site remediation	[4]	*Measurement Technology*	*[3]*		
Basics of waste management	[3]						
Hydrogeology	[5]						
	[31]		[29]		[30]		[29]

PATHWAY #7

CONTACT: Prof. dr. sc. Biljana Kovačević-Zelić (biljana.kovacevic-zelic@rgn.hr)

Study goals in the mobility semester

- **Rock mechanics:** Getting to know the basic characteristics of rocks, procedures of laboratory and field test methods, rock mass classifications, and estimation of rock mass strength and deformability. Understanding of rock mass state and behavior at different conditions in rock engineering.
- **Soil mechanics 1:** Fundamental understanding of engineering properties and mechanical behavior of soils; application of soil mechanics principles in geotechnical engineering.
- **Soil mechanics 2:** Mining and geotechnical activities are closely connected with soil mechanics, which is used to analyse the shear strength and deformations within natural and man-made soil structures or structures that are in soil. The objective is to provide knowledge of the applications of limit equilibrium and limit plasticity analysis methods to stability problems in geotechnical engineering, such as slopes, lateral earth pressures on retaining structures, and bearing capacities of foundations.
- **Geotechnical structures:** Students will acquire the principal knowledge about investigation, design, construction, monitoring, and maintenance of different types of geotechnical structures, such as: construction pits, landslides, embankments, dams, and retaining walls.
- **Ground improvement:** Introduction to various techniques of soil and rock improvement, application of ground improvement techniques in the design and construction of various facilities in mining, geotechnical, hydrotechnical engineering, and environmental protection.
- **Underground structures:** The aim is to familiarize students with methods of making horizontal, inclined and vertical underground chambers.
- **Statistics:** Adoption of basic concepts from the area of probability and their application in building models for statistical analysis. Getting acquainted with basic statistical methods and acquiring skills for their application in technology and natural sciences.
- **Measurement Technology:** Understanding the basic concepts, basic laws and principles related to the measurement techniques. Use of basic and advanced statistical tools to analyze the results. Calculating errors of indirect measurements. Use signal properties for the purpose of performing quality measurements. Getting acquainted with the properties and limitations of measuring transducers (sensors). Calculation of the measurement uncertainty of the result.

PATHWAY #8

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

MINING ENGINEERING

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Statistics	[4.5]	Theory and practice in geomechanics	[6]	Underground chambers	[6]	Projecting in mining	[7]
Chemistry for miner	[4.5]	Computer Aided Geological Modelling and Geostatistics	[5]	Mining law and regulations	[3]	Management	[2]
Applied geophysics I.	[6]	Project management, appraisal and Risk Evaluation	[4]	Technology of nonmetallic raw materials	[6]	Master thesis	[21]
Mineral processing II.	[6]	GIS in Mining	[3]	3 Optional courses	[15]		
2 Optional courses	[9]	Integrated analysis of deformations in geomechanical engineering	[5]	*Traffic routes*	*[4]*		
Demolition of structures	*[3.5]*	Foreign language	[2]	*Economic geology*	*[4]*		
Measurement technology	*[3.5]*	Excavation design in open pit mining	[5]	*Ventillation of underground rooms and tunnels*	*[5]*		
Numerical mathematics	*[3.5]*			*Economics evaluation of projects*	*[5]*		
Geoinformatics	*[4.5]*			*Testing and monitoring geotechnics*	*[5]*		
Engineering geology	*[4.5]*			*Ground improvement*	*[6]*		
Mine surveying	*[4.5]*			*Landfills*	*[6]*		
Renewable energy	*[4.5]*			*Recycling and waste treatment*	*[7]*		
Industrial mineral deposits	*[5.5]*						
	[30]		[30]		[30]		[30]

PATHWAY #8

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

Study goals in the mobility semester

- **Theory and practice in geomechanics:** Presentation of foundations of Theory of Elasticity and its application in Rock and Soil Mechanics. Introduction of fundamental concepts of rock and soil mechanics and their application in surface and underground mining.

- **Computer Aided Geological Modelling and Geostatistics:** Developing basic skills in computer modelling of 3D objects. Introduction to the principles of digital modelling of typical geological structures. Introduction to the methods of deposit parameters estimation and resources evaluation.

- **Project management, appraisal and Risk Evaluation:** The course combines two groups of topics: basics of mineral economics and financial management, and introduction to project management. Part A) Introducing the concept of time value of money and present the methods used to evaluate investment projects. Different techniques are illustrated by examples and case studies. The range of application as well as the advantages and disadvantages of each method are discussed. The issues of inflation and risk analysis are included. Part B) Introduction to project management basic concepts, methods and tools, as well as presentation of the issues of effective communication in project teams, group behavior and leadership.

- **GIS in Mining:** The course is an introduction to map algebra and spatial statistics for determination and modelling of mining related ground movements. The purpose of the course is to introduce the students to the principles and applications of map algebra and spatial statistics to determine surface deformation models and mining terrain parameters, as well as to construct relationship models between surface deformations and causative factors.

- **Integrated analysis of deformations in geomechanical engineering:** Fundamental understanding of integrated analysis of deformations using the combination of monitoring and numerical modelling of deformations, which is essential for studying the processes occurring in engineering structures and in rock mass at the construction and post-construction stages. To understand the fully automated monitoring principles, data collection, and processing.

- **Excavation design in open pit mining:** Introduction and explanation of problems related to technology of mechanized mining machines of different types and sizes used in open pit mining. Relationships between parameters characterizing the geometry of the workplace and the process of digging, controlling machine work process in order to achieve the proper efficiency level and forecasting the efficacy in different geological-mining conditions. Preparing students to particular tasks completion in the area of work technology and the choice of technological system for the project of excavation, and carrying out technological analysis of bucket-wheel excavator work.

PATHWAY #9

CONTACT: Ass. prof. Vječislav Bohanek (vjecislav.bohanek@rgn.hr)

MINING ENGINEERING

1st (summer) - [ECTS]		2nd (winter) - [ECTS]		3rd (summer) - [ECTS]	
Theory and practice in geomechanics	[6]	Soil mechanics 2	[6]	Mineral processing systems	[3]
Computer Aided Geological Modelling and Geostatistics	[5]	Applied geophysics 1.	[6]	Free elective	[2]
Project management, appraisal and Risk Evaluation	[4]	Blasting 2	[6]	Foreign language	[1]
Engineering Geophysics	[3]	Underground chambers	[6]	Digital mine	[2]
Integrated analysis of deformations in geomechanical engineering	[5]	Tunnelling	[6]	Operation research	[3]
Foreign language	[2]	*Statistics*	*[5]*	Diploma seminar	[2]
Excavation design in open pit mining	[5]	*Measurement Technology*	*[3]*	Free elective	[2]
		Applied Geophysics	*[6]*	Master thesis	[15]
	[30]		[30]		[30]

PATHWAY #9

CONTACT: Ass. prof. Vječislav Bohanek (vjecislav.bohanek@rgn.hr)

Study goals in the mobility semester

- **Soil mechanics 2:** Mining and geotechnical activities are closely connected with soil mechanics, which is used to analyse the shear strength and deformations within natural and man-made soil structures or structures that are in soil. The objective is to provide students with knowledge of applications of limit equilibrium and limit plasticity analysis methods to stability problems in geotechnical engineering, such as slopes, lateral earth pressures on retaining structures, and bearing capacities of foundations.

- **Applied geophysics 1.:** Introduction to surface geophysical research with practical application of methods in defining geological structure and terrain composition.

- **Blasting 2:** Major goals of this course are: 1) Design, execution and supervision of blasting works during excavation and exploitation of mineral raw materials, and in the construction of infrastructural facilities: roads, construction pits, hydropower facilities, underground chambers and tunnels, and other structures. 2) Design, execution and supervision of special blasting works such as demolition and underwater blasting.

- **Underground chambers:** The aim is to familiarize students with methods of making horizontal, inclined and vertical underground chambers.

- **Tunnelling:** Obtaining the theoretical and practical knowledge about rock, and primary and secondary supporting system interaction for a successful tunneling work.

- **Statistics:** Adoption of basic concepts from the area of probability and their application in building models for statistical analysis. Getting acquainted with basic statistical methods and acquiring skills for their application in technology and natural sciences.

- **Measurement Technology:** Understanding the basic concepts, basic laws and principles related to the measurement techniques. Use of basic and advanced statistical tools to analyze the results. Calculating errors of indirect measurements. Use signal properties for the purpose of performing quality measurements. Getting acquainted with the properties and limitations of measuring transducers (sensors). Calculation of the measurement uncertainty of the result.

- **Applied Geophysics:** Introduction to surface geophysical research with practical application of methods in defining geological structure and terrain composition.

PATHWAY #10

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

MINING AND GEOTECHNICAL ENGINEERING

Version A: for students starting the Mining and Geotechnical Engineering MSc in the winter semester.

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Engineering statistics	[2]	Digital Mine	[2]	Advanced Surface Mining Methods	[5]	Occupational health and safety	[2]
Numerical methode and optimization	[2]	Environmental management	[3]	Mining seminar 2.	[3]	Design of mineral processing technologies	[3]
Computer science for engineers	[2]	Mineral processing systems	[3]	Thesis work I.	[15]	Thesis work II.	[15]
Applied geology and petrography	[3]	Excavation design in openpit mining	[5]	Advanced rock mechanics	[5]	Applied physical chemistry	[3]
Blasting technique	[3]	Operations research	[3]	Mining Engineering Design	[4]	Alluvial mining methods	[4]
Spatial informatics	[3]	Computer aided geological modeling and geostatistics	[5]			Maintenance and fault diagnostics	[2]
Thermodynamics	[3]	Project management, appraisal and Risk Evaluation	[4]				
Mechanized Excavation and Haulage	[4]	Occupational health and safety	[2]				
Quality management	[2]	Principles and application of InSAR and GIS in mining	[5]				
Legal and economics studies for mining	[2]						
Hydraulic power supply	[2]						
Tunnel and underground mine design	[3]						
	[31]		[32]		[32]		[29]

PATHWAY #10

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

Version B: for students starting the Mining and Geotechnical Engineering MSc in the summer semester.

1st (summer) - [ECTS]		2nd (winter) - [ECTS]		3rd (summer) - [ECTS]		4th (winter) - [ECTS]	
Measuring and automation	[2]	Engineering statistics	[2]	Project management, appraisal and Risk Evaluation	[4]	Advanced Surface Mining Methods	[5]
Applied physical chemistry	[3]	Numerical methode and optimization	[2]	Occupational health and safety	[2]	Mining seminar 2.	[3]
Environmental impact assessment	[2]	Computer science for engineers	[2]	Mineral processing systems	[3]	Thesis work I.	[15]
Mineral processing	[4]	Applied geology and petrography	[3]	Principles and application of InSAR and GIS in mining	[5]	Advanced rock mechanics	[5]
Reclamation and landscaping	[2]	Blasting technique	[3]	Thesis work II.	[15]	Mining Engineering Design	[4]
Advanced Surface Mine Design and Construction	[5]	Spatial informatics	[3]				
Alluvial mining methods	[4]	Thermodynamics	[3]				
Maintenance and fault diagnostics	[2]	Mechanized Excavation and Haulage	[4]				
Mining seminar 1.	[3]	Quality management	[2]				
Elective 2. Underground mining methods	*[3]*	Legal and economics studies for mining	[2]				
		Hydraulic power supply	[2]				
		Tunnel and underground mine design	[3]				
	[30]		[31]		[29]		[32]

PATHWAY #10

CONTACT: Dr Gabriela Paszkowska (gabriela.paszkowska@pwr.edu.pl)

Study goals in the mobility semester

- **Digital Mine**: Ability to create utility applications in the C / C ++ and LabVIEW environment. Embedded systems, their construction, selection of components, designing, programming and their exploitation. Advances of technology & methods of future mining operations. Social competencies.
- **Environmental management**: Systems of environmental management; rational and sustainable management of environmental components; review, standardization, benefits and obligations of environmental management systems; relationship between an environmental management system and a quality management system; informative methods of supporting the implementation of environmental management systems.
- **Mineral processing systems**: Production issues in the mineral industry as an optimization problem of managing the operation of complex technological systems. Modern methods of off-line analysis of complex systems, mineral processing and waste. Skills to construct simple models and algorithms for mining operations and tailings, and their implementation using a spreadsheet supported by VBA program. Preparation and presentation of reports.
- **Excavation design in open pit mining**: Introduction and explanation of problems related to technology of mechanized mining machines of different types and sizes used in open pit mining. Relationships between parameters characterizing the geometry of the workplace and the process of digging. Controlling machine work process. Skills on work technology and the choice of technological system for the excavation project.
- **Operations research**: Mathematical decision models used in management: linear programming models; models of planning, deposits and costs of projects; queueing system models; digital simulation models; learning of qualitative understanding, and others.
- **Computer aided geological modeling and geostatistics**: Developing basic skills in computer modelling of 3D objects. Introduction of the principles of digital modelling of typical geological structures. Introduction to the methods of deposit parameters estimation and resources evaluation.
- **Project management, appraisal and Risk Evaluation**: Basics of mineral economics and financial management, and introduction to project management. Part A) Introducing the concept of time value of money and present the methods used to evaluate investment projects. Different techniques, issues of inflation and risk analysis are included. Part B) Introduction to project management basic concepts, methods and tools.
- **Occupational health and safety**: Principles of occupational risk assessment in accordance with relevant standards. Use of softwares and methods.
- **Principles and application of InSAR and GIS in mining**: Introduction to the principles and applications of Interferometric Synthetic Aperture Radar. Introduction to the principles and applications of map algebra and spatial statistics to determine surface deformation models and mining terrain parameters, as well as to construct relationship models between surface deformations and causative factors.

PATHWAY #11

CONTACT: Dr. Eng. Kornel Frydrych (kornel_f@agh.edu.pl)

MINING AND GEOTECHNICAL ENGINEERING

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Engineering statistics	[2]	Hazards monitoring in underground mine	[2]	Advanced Surface Mining Methods	[5]	Occupational health and safety	[2]
Numerical methods and optimization	[2]	Environmental risk assessment in exploration and mining	[2]	Mining seminar 2.	[3]	Design of mineral processing technologies	[3]
Computer science for engineers	[2]	Information technologies in mining	[2]	Thesis work I.	[15]	Thesis work II.	[15]
Applied geology and petrography	[3]	Mine environment engineering	[2]	Advanced rock mechanics	[5]	Applied physical chemistry	[3]
Blasting technique	[3]	Selected problems of environmental protection	[2]	Mining Engineering Design	[4]	Alluvial mining methods	[4]
Spatial informatics	[3]	Rudiments of mining	[4]			Maintenance and fault diagnostics	[2]
Thermodynamics	[3]	Selected problems of surface mining	[4]			Mineral processing	[4]
Mechanized Excavation and Haulage	[4]	Mining CAD	[3]				
Quality management	[2]	Selected problems of underground construction	[2]				
Legal and economics studies for mining	[2]	Corporate social responsibility	[3]				
Hydraulic power supply	[2]	Selected problems of mine planning and economics	[2]				
Tunnel and underground mine design	[3]	Databases in environmental monitoring	[2]				
	[31]		[30]		[32]		[33]

PATHWAY #11

CONTACT: Dr. Eng. Kornel Frydrych (kornel_f@agh.edu.pl)

Study goals in the mobility semester

- **Hazards monitoring in underground mine:** Methods to detect of gases in the mine air, criteria for early detection of underground fires, evaluation of early detection of endogenous fires, selection of the proper monitoring system for hazard fire, and determination of the location of the sensors in mine.
- **Environmental risk assessment in exploration and mining:** Presentation of methods to limit the adverse impact of mining on the environment.
- **Information technologies in mining:** Gathering sources to use tools in engineering work. How to conduct engineering work using information tools. Design basic tasks using the methods and means of information. Data analysis using statistical inference collected in laboratory and field studies.
- **Mine environment engineering:** Waste management in mining and the impact of mining waste on the environment; how to reduce the impact of mining in the environment. Identification of phenomena occurring as a result of mining activities; environmental impact analysis of mining and ways to limit it.
- **Selected problems of environmental protection:** Environmental degradation, remediation methods, and use potential of post-industrial landscape.
- **Rudiments of mining:** Role of mining for the global economy, geological characterization of orebodies, typical mining equipment and their application.
- **Selected problems of surface mining:** It covers concepts and procedures that will allow the student to perform basic foundations in the surface mine planning and design, and will serve as a basis for good working methodology and processes in Geovia Surpac.
- **Mining CAD:** Underground cut of useful minerals. Module includes a structure of prospecting, access, preparatory and exploitation excavations.
- **Selected problems of underground construction:** How to design underground structures a in various geological and geotechnical conditions.
- **Corporate social responsibility:** Philosophy of CSR principles of sustainable development and how to conduct this process in a company.
- **Selected problems of mine planning and economics:** Business management in mining. The economics of entities will be identified related to their specificity resulting from owned geological and technical resources.
- **Databases in environmental monitoring:** Multidimensional data analysis. Graphical way of data interpretation. Determination of water supplies. Water treatment processes. Evaluation of water quality. Designing of parameters of water reservoirs. Statistical approach to water waste treatment processes. Hazardous and radioactive pollutants evaluation. Modeling of environmental processes.

PATHWAY #12

CONTACT: Dr. Eng. Kornel Frydrych (kornel_f@agh.edu.pl)

MINING ENGINEERING

1st (winter) - [ECTS]		2nd (summer) - [ECTS]		3rd (winter) - [ECTS]		4th (summer) - [ECTS]	
Statistics	[4.5]	Rudiments of mining	[4]	Underground chambers	[6]	Projecting in mining	[7]
Chemistry for miner	[4.5]	Economic geology	[4]	Mining law and regulations	[3]	Management	[2]
Applied geophysics I.	[6]	Selected problems of underground construction	[2]	Technology of nonmetallic raw materials	[6]	Master thesis	[21]
Mineral processing II.	[6]	Information technology in mining	[2]	3 Optional courses	[15]		
2 Optional courses	[9]	Mining CAD	[3]	*Traffic routes*	*[4]*		
Demolition of structures	*[3.5]*	Corporate social responsibility	[3]	*Economic geology*	*[4]*		
Measurement technology	*[3.5]*	Mine fire	[2]	*Ventillation of underground rooms and tunnels*	*[5]*		
Numerical mathematics	*[3.5]*	Selected problems of mine planning and economics	[2]	*Economics evaluation of projects*	*[5]*		
Geoinformatics	*[4.5]*	Environmental risk assessment in exploration and mining	[2]	*Testing and monitoring geotechnics*	*[5]*		
Engineering geology	*[4.5]*	GIS and remote sensing	[4]	*Ground improvement*	*[6]*		
Mine surveying	*[4.5]*	Applied computing	[3]	*Landfills*	*[6]*		
Renewable energy	*[4.5]*			*Recycling and waste treatment*	*[7]*		
Industrial mineral deposits	*[5.5]*						
	[30]		[31]		[30]		[30]

PATHWAY #12

CONTACT: Dr. Eng. Kornel Frydrych (kornel_f@agh.edu.pl)

Study goals in the mobility semester

- **Rudiments of mining:** Role of mining for the global economy. Geological characterisation of orebodies in relation to potential mining technology. Scope and various types of mining activity. Typical mining equipment and their application. Mining and natural threats associating the technology. Examples of different mines ideas.
- **Economic geology:** This course provide detailed geological characteristics of mineral deposits (metallic, coal, salt), and characteristics of selected, important deposits (Bushveld, Witwatersrand, Kupferschiefer etc.).
- **Selected problems of underground construction:** How to design underground structures and how to perform them in various geological and geotechnical conditions.
- **Information technology in mining:** Gathering sources to use tools in engineering work. How to conduct engineering work using information tools. Design basic tasks using the methods and means of information. Data analysis using statistical inference collected in laboratory and field studies.
- **Mining CAD:** The module is connected with underground cut of useful minerals, both hard coal, ore and salt. Module includes a structure of prospecting, access, preparatory, and exploitation excavations.
- **Corporate social responsibility:** Philosophy of CSR principles of sustainable development and how to conduct this process in a company.
- **Mine fire:** As part of the course, the student receives knowledge about fires in underground mines.
- **Selected problems of mine planning and economics:** Business management in mining. The economics of entities will be identified related to their specificity resulting from owned geological and technical resources.
- **Environmental risk assessment in exploration and mining:** Presentation of methods to limit the adverse impact of mining on the environment. Examples of the impact of various types of mining activities on the environment.
- **GIS and remote sensing:** The course aims at acquiring satellite imagery of various sources and basic processing and analysis of images, as well as interpretation for geological and environmental applications.
- **Applied computing:** Student using different software is able to visualize different kinds of geological data.

PATHWAY #13

CONTACT: Prof. dr. sc. Biljana Kovačević-Zelić (biljana.kovacevic-zelic@rgn.hr)

MINING ENGINEERING

1st (summer) - [ECTS]

Rudiments of mining	[4]
Economic geology	[4]
Selected problems of surface mining	[4]
Physical properties of rock and soils	[2]
Drilling	[2]
Selected problems of underground construction	[2]
Information technology in mining	[2]
Mining CAD	[3]
Corporate social responsibility	[3]
Advanced statistics	[2]
Elective modules block	[2]
	[30]

2nd (winter) - [ECTS]

Rock mechanics	[5]
Underground chambers	[6]
Ground improvement	[5]
Blasting 2.	[5]
Advanced mineral processing	[6]
Environmental management	[2]
Statistics	*[5]*
Measurement Technology	*[3]*
Applied Geophysics	*[6]*
	[30]

3rd (summer) - [ECTS]

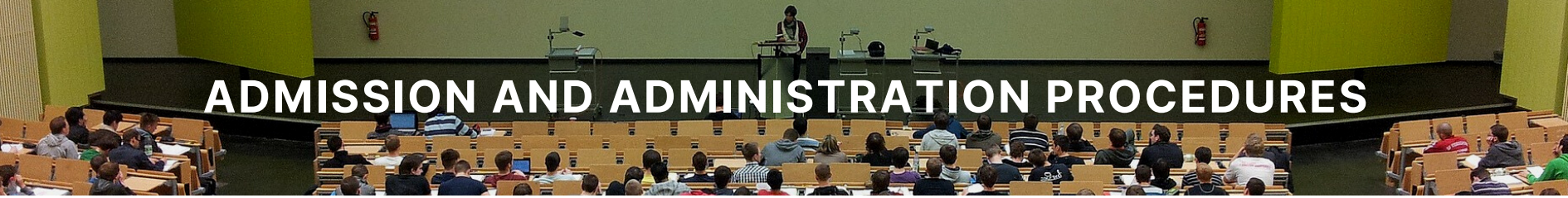
Mine fire	[2]
Selected problems of mine planning and economics	[2]
Diploma seminar	[2]
Elective modules block (2 courses to be selected)	[2]
Solution mining in salt deposits	*[2]*
Selected problems of environmental protection	*[2]*
Mine environmental engineering	*[2]*
Hazards monitoring in underground mine	*[2]*
Hydraulics of water wells	*[2]*
Geostatistics	*[2]*
Databases in environmental monitoring	*[2]*
MSc Thesis	[20]
	[30]

PATHWAY #13

CONTACT: Prof. dr. sc. Biljana Kovačević-Zelić (biljana.kovacevic-zelic@rgn.hr)

Study goals in the mobility semester

- **Rock mechanics:** Getting to know the basic characteristics of rocks, procedures of laboratory and field test methods, rock mass classifications, and estimation of rock mass strength and deformability. Understanding of rock mass state and behavior at different conditions in rock engineering.
- **Underground chambers:** The aim is to familiarize students with methods of making horizontal, inclined and vertical underground chambers.
- **Ground improvement:** Introduction to various techniques of soil and rock improvement, application of ground improvement techniques in the design and construction of various facilities in mining, geotechnical, hydrotechnical engineering, and environmental protection.
- **Blasting 2.:** Major goals of this course are: 1) Design, execution and supervision of blasting works during excavation and exploitation of mineral raw materials, and in the construction of infrastructural facilities: roads, construction pits, hydropower facilities, underground chambers and tunnels, and other structures. 2) Design, execution and supervision of special blasting works such as demolition and underwater blasting.
- **Advanced mineral processing:** The aim of the course is to introduce the theoretical basics, apparatus and procedures used in the beneficiation of solid mineral raw materials. Students adopt theoretical knowledge of the beneficiation process, and of the apparatus and procedures used in it.
- **Environmental management:** Learn EU/national legislative framework of environmental management, familiarize with the procedures for environmental permitting of mining projects and industrial plants, apply mandatory and voluntary instruments of environmental management.
- **Statistics:** Adoption of basic concepts from the area of probability and their application in building models for statistical analysis. Getting acquainted with basic statistical methods and acquiring skills for their application in technology and natural sciences.
- **Measurement Technology:** Understanding the basic concepts, basic laws and principles related to measurement techniques. Use of basic and advanced statistical tools to analyze the results. Calculating errors of indirect measurements. Use signal properties for the purpose of performing quality measurements. Getting acquainted with the properties and limitations of measuring transducers (sensors). Calculation of the measurement uncertainty of the result.
- **Applied Geophysics:** Introduction to surface geophysical research with practical application of methods in defining geological structures and terrain composition.



ADMISSION AND ADMINISTRATION PROCEDURES

Examination and Organization

- The curriculum calendar for pathways is set up for each pathway individually
- Students pursue their studies in the Partner Universities according to the milestones in the MOBI-US mobility pathways and the completed academic requirements are considered fulfilled by the partners according to the general rules of credit recognition
- During the mobility semester, studies and examinations follow the local rules of the Partner University where the student is currently studying
- The periods of study and examinations at the receiving university will be fully recognized by the sending university
- A Transcript of Records will be issued by the receiving institution no later than five weeks after the assessment period has finished at the receiving institution
- Grade conversion should be done through ECTS grading system

Students' application and selection criteria

- Students will submit their application according to the rules and deadlines at the home university. Common standards for admission into the MOBI-US structured mobility program will be checked by the local staff of Partner Universities
- Applicants must fulfil the following requirements:
  a. Be enrolled in the actual master programme of the mobility pathway at the home university
  b. Must have an adequate knowledge of written and spoken English, equivalent to B2 according to the CEFR
  c. As a plus, students' entrepreneurial potential, social skills, extracurricular activities might be considered

Fees and student's financial responsibility

The receiving university applies its regular policy towards the student mobilities within the frame of the MOBI-US network, similar to other Erasmus+ or CEEPUS mobilities. All students are financially responsible for travel, travel documentation, books, living expenses, international insurance, and Student Association/General Services Charges (if any).

MOBI-US

an EIT RawMaterials project

CONSORTIUM

Networking partners

MISKOLCI EGYETEM

University of Zagreb
FACULTY OF MINING, GEOLOGY AND PETROLEUM ENGINEERING

AGH
AGH University of Science and Technology

Wrocław University of Technology

Mentoring partners

Aalto University

LPRC LA PALMA RESEARCH CENTRE

TU WIEN