COURSE LEARNING OUTCOMES AND LEARNING CONTENT

Geohazards and Climate Change

Course name: **Extreme weather hazards**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the natural processes occurring in the natural environment, their causes, mechanisms and effects as well as geohazards associated with them;
2. knows and understands the functioning of the climate and the mechanisms of atmospheric phenomena and the impact of anthropogenic activity on their formation;
3. knows and understands to an in-depth degree the student understands and is able to characterize climatic variability in different time scales (annual, ten-year, hundred-year, thousand-year) and their causes;
4. knows and understands the impact of climate change, extreme phenomena and geohazards on socio-economic phenomena and processes to an in-depth degree;
5. knows and understands to an in-depth degree the relationship between climate and environmental changes and the need to develop adaptation strategies;
6. knows and understands the advanced conceptual apparatus regarding climate change, natural environment and geohazards;
7. knows and understands to an in-depth degree the literature concerning the studied field and the basic literature of specific sciences (natural or social) related to this field of study;
8. knows and understands to an in-depth degree the latest trends in the development of scientific research in the world and the application of scientific achievements in practice in the field of study.
in terms of skills:
1. differentiates the natural and anthropogenic causes of climate change and the resulting changes in the natural environment and geohazards;
2. critically assesses future scenarios of climate change and related changes in the natural environment and geohazards;
3. uses specialized terminology in English to an extended degree and reads advanced scientific publications with understanding;
4. finds and selects the necessary information from professional literature and other sources in English;
5. applies in practice the principles of environmental management to improve the quality of human life;
6. describes in depth the components of the geographical environment and the interdependencies between them;
7. cooperates in crisis planning teams and resolve conflict situations.
in terms of social competences:
1. is ready to recognize the impact of natural phenomena (including extreme ones) on the socio-economic sphere, as well as anthropogenic activity on various components of the natural environment in various time and spatial scales;
2. is ready to think and act creatively;
Course learning content:
Introduction to extreme weather hazards (definitions, data sources).
Discussion of the basic processes and laws concerning the development of extreme weather hazards in the synoptic and mesoscale.
The influence of the vertical profile of wind, humidity and temperature on the occurrence of convective hazards.
Methods of forecasting and monitoring extreme weather hazards.
Climatological aspects of extreme weather hazards and their relationship to climate change.
Methods of literature review and proper interpretation of research results. Evaluation of available data sources used in the study of climate trends of extreme phenomena and discussion of their advantages and disadvantages.

Course name: **Extreme hydrological phenomena**
On successful completion of this course, a student

in terms of knowledge:
1. understands the influence of the natural environment and human activities on the development of extreme hydrological phenomena (droughts and floods) on different scales;
2. understands an increasing role of extreme hydrological phenomena in shaping the directions of socio-economic development;
3. understands the importance of adaptation strategies in mitigation of the consequences of extreme hydrological phenomena on different scales;
4. knows the latest scientific achievements related to the course of extreme hydrological phenomena and methods of their control.
in terms of skills:
1. analyzes and interprets the causes and course of extreme hydrological phenomena and predicts their effects based on the obtained knowledge in the field of natural and socio-economic sciences;
2. proposes solutions of mitigating the impacts of extreme hydrological phenomena on the socio-economic development;
3. determines the importance of the physico-geographical features of the catchment, climate change and human activity in shaping the spatio-temporal differentiation of extreme hydrological phenomena in different geographical zones.
in terms of social competences:
1. is prepared to engage in science communication, teaching and popularization the knowledge on extreme hydrological phenomena;
2. is prepared to find solutions aiming to mitigate the impacts of extreme hydrological phenomena on the socio-economic development.
Course learning content:
Introduction to extreme hydrological phenomena: research subject and tasks.
Analysis of the impact of natural conditions and human activity on extreme hydrological phenomena.
Extreme hydrological phenomena from the Polish perspective - threats, impacts and solutions.
The predicted directions of development of extreme hydrological phenomena in the light of latest scientific achievements.

Course name: **Programming and data analysis in R**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands a variety of programming concepts, such as what programming languages are, what a working directory is, etc.;
2. knows and understands methods and techniques used for data analysis in the environmental research;
3. knows and understands up to date trends in data analysis.
in terms of skills:
1. uses programming languages to dissect information from various sources;
2. reads, processes, writes, and visualizes data from various sources;
3. calculates basic statistics and perform statistical tests using programming languages;
4. automates some parts of data analysis.
in terms of social competences:
1. is prepared to perform data analysis of various new datasets.
Course learning content:
Introduction to the course.
Introduction to the R programming language.
Data reading, processing, and writing in R (readxl, dplyr, tidyr, writexl).
Data visualization.
Basic statistics and statistical tests.
Writing your own functions and loops.

Course name: **Master's degree seminar**
On successful completion of this course, a student
in terms of knowledge:
1. knows statistical and mathematical tools and methods used in geosciences;
2. understands environmental processes and posses the tools to describe and to forecast environmental changes;
3. knows the most up to date trends in geosciences.
in terms of skills:

1. infers from various scientific sources;
2. independently collects the bibliography and to write a dissertation.

in terms of social competences:

1. is ready to efficiently communicate, discuss and argue scientific issues;
2. takes the responsibility for health and safety and the entrusted equipment.

Course learning content:

Desk, field and laboratory research methods.
Identification of the research aims and formulation of the research hypothesis.
Identification, selection, critical assessment of source of data and information.
Writing of the research dissertation and preparation of graphic materials.
Verification of research results, drawing conclusions and formulation of future research avenues.

Course name: **Environmental and social effects of natural disasters**

On successful completion of this course, a student

in terms of knowledge:

1. knows the processes operating in the natural environment, their causes, mechanisms, consequences and associated geohazards;
2. understands and is able to explain complex socio-economic processes in the local, regional and global scale and their influence on the occurrence of extreme environmental events;
3. understands the influence of the climate change, extreme environmental events and geohazards on the socio-economic processes;
4. understands relationship between climate and environmental change and necessity of formulation of the adaptation strategies;
5. knows advanced vocabulary associated with climate change, natural environment and geohazards;
6. knows the literature in the field of climate change, geohazards as well as basic environmental and social research;
7. knows the most up to date trends in science and implementation of the newest scientific achievements in studies field.

in terms of skills:

1. to an extended degree uses the scientific terminology and vocabulary, read the advanced scientific literature with understanding;
2. describes in an extended degree environmental components and their relationship.

in terms of social competences:

1. is prepared to implement and to popularize actions serving the environmental protection;
2. is prepared to identify the influence of environmental processes onto the socio-economic processes, and also influence of anthropogenic activities onto the various components of the natural environment in various timescales;
3. is prepared to undertake the cooperation within the crisis management teams and solve the conflicts.

Course learning content:

Discussing the main types of natural disasters (earthquakes, tsunami, floods, mass movements, droughts, hurricanes).
The effects of natural disasters on the evolution of environment (examples of reactions of rivers and coasts to natural disasters, e.g. the formation of river avulsions, river bed incision as a reaction to series of intensive floods, coastal erosion as the effect of sea storms, sea level rise and sediment deficit).
The effects of natural disasters on the evolution of environment – continued (examples of reactions of montane and aeolian environments to natural disasters, e.g. effects of increase in climate humidity on the intensity of mass movements in montane areas).
The influence of natural disasters on economy of selected countries (examples of effects of earthquakes, floods and hurricanes on the economy of e.g. the Caribbean and Andean countries).
Discussing examples of cities situated in areas of the occurrence of natural hazards (e.g. volcano eruption, sea level rise).
Mitigating the effects of natural disasters (examples of precautions and engineering solutions taken by cities and regions affected and/or endangered by the occurrence of e.g. earthquakes, floods, sea level rise).

Course name: **Arctic climate change**

On successful completion of this course, a student

in terms of knowledge:

1. presents and understands the concepts of geography and territorial differentiation of the Arctic and its natural and socio-economic phenomena;
2. characterizes the diversity of the polar regions in terms of climate, cryosphere and human activity and knows how to connect these issues in a regional and pan-arctic context.

in terms of skills:

1. describes the functioning of the natural environment of the polar regions and its links with human activity. The student understands the importance of climate change in the Arctic for the global heat-flux system;
2. understands the interdependencies between the elements of biodiversity and geodiversity of the polar regions. The student is able to quantify and discuss the trends and to compare the climate change variables across the space and time;
3. interprets sources of geographic information and time-series records in obtaining information about the polar environment change;
4. describes long vs. short-term trends in arctic climate change.

in terms of social competences:

1. is prepared to verify the fake news content on climate change in the Arctic.

Course learning content:

The Arctic and Climate Change - where? when? why?
Impact of permafrost thawing for nature and human activity in the Arctic.
Carbon cycle in the Arctic.
Boreal forest and tundra wildfires: causes and consequences.
The effects of diminishing sea ice on climatic change in the Arctic region and beyond.
Ecological changes in the Arctic: tundra greening and browning, ecological mismatch.
How native Arctic communities face climate change.
Microplastic in the Arctic.
Geopolitical ascpects of the Arctic.

Course name: **Anthropogenic climate change**

On successful completion of this course, a student

in terms of knowledge:

1. understands and classifies manifestations of globalization processes, such as global changes environment and their impact on the ecological situation, natural and socio-economic regions and countries;
2. knows conflicts between natural and socio-cultural components of the Earth's landscape shell and thoroughly explains the reasons for their occurrence andoptimal ways to solve them;
3. understands the need for forecasting (modelling) changes in the natural environment in terms of planned human activity;
4. knows environmental problems caused by anthropopressure.

in terms of skills:

1. has the skills to use both the conceptual apparatus and methods of climate change analysis and the processes that cause them;
2. describes the world by explaining the causes of components differentiation of the natural environment and sociocultural and economic phenomena.

in terms of social competences:

1. is aware of biodiversity and geodiversity and knows the need to apply rules of conduct based on feeling responsible for the state of ecosystems and resource searth.

Course learning content:

Building the atmosphere. The importance of energy streams in shaping the Earth's climate. 0-dimensional model energy balance.
The importance of greenhouse gases in the radiation balance, the lifetime of greenhouse gases and their global warming potential.
The carbon cycle in nature and its importance for the operation of the climate system.
Models used for climatic projection and reconstruction. Climate change scenarios. IPCC Reports.
The currently observed effects of climate change on the regional and global scale. Attribution of extreme phenomena to climate change. Consequences and possibilities counteracting contemporary climate change.
Mechanisms of global climate policy against the background of sociological, business and political aspects.

Course name: **UAV application in environmental studies**

On successful completion of this course, a student
in terms of knowledge:
1. knows various components of drone, their functions and the physical basis of the functioning of unmanned aerial vehicles (UAV);
2. knows how to plan a UAV flight to acquire remote sensing data;
3. knows and understand the theoretical basis of obtaining remote sensing data from low altitudes;
4. knows what are the possibilities of using particular fragments of the electromagnetic spectrum to study the natural environment.
in terms of skills:
1. assesses changes in the landscape based on aerial images;
2. proposes the use of appropriate low-altitude remote sensing methods to solve a specific research goal;
3. interprets objects and surfaces related to environmental management in UAV photographs and images.
Course learning content:
Characteristics of unmanned aerial vehicles (UAV) as a remote sensing platforms.
Legal basis for the use of UAV in EU.
Remote sensing sensors for UAVs operating in the optical range of the electromagnetic spectrum.
Thermal, lidar and radar sensors for UAVs.
Examples of the use of UAVs in environmental research.
Interpretation of photographs and images recorded from UAV in the context of environmental management.

Course name: **Methods of climate change reconstruction**
On successful completion of this course, a student
in terms of knowledge:
1. knows in depth what climate reconstruction methods can be applied to various timescales;
2. knows the limitations of the climate reconstruction methods;
3. knows the impact of the development of the climate reconstruction methods for the understanding of the climate changes in the past.
in terms of skills:
1. interprets paleoclimatic data based on various proxies;
2. reconstructs various elements of paleoclimate based on the raw data sourced from selected proxies;
in terms of social competences:
1. is prepared to critically assess the current state of knowledge on climate changes in the past.
Course learning content:
Theoretical introduction into the topic of climate reconstruction.
Presentation of selected qualitative and quantitative climate reconstruction methods.
Examples of calculations of paste temperatures and quantification of hydroclimate based on raw proxy data.
Discussion of uncertainty of selected climate reconstruction methods.
Presentation of selected validation methods of the climate reconstruction.

Course name: **Extreme events in changing climate - study of compound events**
On successful completion of this course, a student
in terms of knowledge:
1. knows what is the compound events, what is their characteristics and how are they unique and different from extreme weather and hydrological events;
2. knows the most up to date examples of case studies of compound meteorological and hydrological events.
in terms of skills:
1. differentiates between extreme weather and hydrological conditions and compound events;
2. identifies the devastating influence of the compound events on the local environment and the society;
3. identifies the most suitable methods of mitigation of the effects of compound events on the environment and society based on the most up to date case studies.
in terms of social competences:
1. is prepared to communicate what are the biggest challenges associated with mitigation of the influence of the compound events on the local society.
Course learning content:

What is the compound events and how it differs from weather and hydrological event? What is unique and characteristic for compound event?
Examples of most recent devastating compound events and their influence on environment and local society.
The most up to date trends in mitigation of the consequences of compound events and methods of preparation of local society for their devastating influence on the local environment and socio-economic situation of the area.

Course name: **Science in practice**
On successful completion of this course, a student
in terms of knowledge:
1. knows the most up to date case study of practical application of geohazards and climate change research.
in terms of skills:
1. identifies applicability of various directions of research on geohazards and climate change;
2. indicates the advantages of the research on geohazards and climate change to society in local, regional and global scale.
3. undertakes cooperation within working groups implementing the scientific achievements in practice.
Course learning content:
Selected case studies of the practical application of geohazards, climate change and Earth science research.
Advatnages and problems of academia-bussiness and academia- various levels of government organizations cooperation.

Course name: **Application of Scanning Electron Microscopy - Energy Dispersive Spectroscopy in Earth sciences**
On successful completion of this course, a student
in terms of knowledge:
1. knows SEM-EDS method that can be used to investigate research problems related to geohazards and environmental changes.
in terms of skills:
1. processes data to solve the selected research problem;
2. presents obtained results as clear and readable diagrams and text;
3. works in a small group, sharing responsibilities and tasks.
Course learning content:
Applications of SEM-EDS to analysis of environmental changes.
SEM-EDS observations of selected samples and/or students' own samples.
Supervised work on students' projects (group work).

Course name: **Biodiversity hot spots: climate and human impact**
On successful completion of this course, a student
in terms of knowledge:
1. knows basic terms connected with biodiversity, hot spots and environmental protection;
2. knows the most threatened biodiverse areas (biodiversity hot spots) in the world;
3. understands the causes and features of the conflict between human activity and the natural environment in biodiversity hot spots;
4. knows palaeoecological methods useful for retrieving information about the long-term functioning of the most biodiverse areas in the world.
in terms of skills:
1. critically reads and analyses scientific sources considering the most biodiverse areas in the world;
2. briefly explains the risks for biodiversity in most endangered biodiverse ecosystems in the world using appropriate scientific language;
3. proposes appropriate scientific techniques to assess the anthropogenic degradation and natural changes of natural habitats in the most biodiverse areas in the world.
in terms of social competences:
1. promotes the necessity of protection of the most biodiverse areas in the world;
2. is ready to communicate risks for human and environmental heritage arising from the degradation of ecosystems in the most biodiverse areas in the world;
3. is ready to cooperate with different authorities to protect biodiverse areas.
Course learning content:

What is biodiversity, biodiversity hot-spot, and why has this concept appeared? Introduction to basic terminology.
Characteristics of biodiversity hot spots in the world. Presentation of the variability of vegetation, the animal world, features of human-nature conflict, and impact of global warming on biodiversity hot spots. Presentation of some palaeoecological methods, examples of study being applied for understanding long-term functioning of ecosystems in key biodiverse areas in the world.

Course name: **Disaster risk management**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the framework of disaster risk management: knows and understands the concept of disaster risk management: definitions and terminology;
2. knows and understands the elements of disaster risk management framework.
in terms of skills:
1. identifies and implements new GIS skills needed to solve the specific problem connected with disaster risk management;
2. prepares an initial draft of disaster risk management plan.
in terms of social competences:
1. is prepared to take action to propose solutions for disaster risk management at local, regional, national and international scales.
Course learning content:
Concept of disaster risk management: definitions, terminology and legal acts at local, regional, national and international scale.
Elements of disaster risk managements framework at local, regional, national and international scale.
Planning an institutional assessment of disaster risk management systems at local, regional, national and international scale.
Workshops in the municipal center of crisis management.
Analysing and interpreting the data connected with disaster risk mnagement: case studies.
Tools and methods for institutional disaster risk assessemnt: case studies.

Course name: **GIS analysis of environmental change and geohazards**
On successful completion of this course, a student
in terms of knowledge:
1. knows GIS and remote sensing methods that can be used to investigate research problems related to geohazards and environmental changes.
in terms of skills:
1. develops a research question or problem related to geohazards or environmental changes;
2. collects spatial data and assess their quality;
3. processes data to solve the selected research problem;
4. develops a personal GIS portfolio;
5. presents obtained results as clear and readable maps, diagrams and text.
in terms of social competences:
1. is ready to work in a small group, sharing responsibilities and tasks;
2. is ready to present results of conducted research in a plain language;
3. is ready assess the credibility of collected data.
Course learning content:
Introduction to applications of GIS to monitoring and analysis of environmental changes and geohazards.
Introductory projects (Mapping landslides and debris flows; assessment of flood effects; fluctuation of glaciers; modelling of soil erosion).
Development of research question/problem (group work).
Supervised work on students' GIS portfolio (group work).
Presentation and discussion of the developed GIS portfolio (poster session or presentations).

Course name: **Climate change adaptation and human resilience**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the concept of low-carbon society;
2. knows and understands what climate changes mean for human life and how communities can build ability to resilience.

in terms of skills:
1. identifies solutions for human resilience in uncertain environmental changes now and in the future.
in terms of social competences:
1. is prepared to take action to ensure human well-being in changing climatic conditions;
2. is prepared to take action to propose solutions for adaptation to climate change at global, regional and local scales.
Course learning content:
Psycho-sociological perception of climate changes.
Low-carbon society: concept and practice.
Adaptation to climate changes at global, regional and local scales: case studies.
Solutions to support human in coping with the negative impact of climate changes.
Countries and communities adaptation to climate change – practical experiences.
Climate change adaptation in food security.
Benefits of sustainable agroforestry.
Blue and green infrastructure in cities in flood prevention in urban areas.
Passive and energy safe buildings, public transport, waste management.
Nature-based solutions for human resilience in uncertain environmental changes.

Course name: **Engineering solutions in geohazards**
On successful completion of this course, a student
in terms of knowledge:
1. knows geotechnical models and their parameters;
2. knows most valuable laboratory and in situ geotechnical tests;
3. knows types of foundations of buildings and structures;
4. knows engineering solutions for soft soils and slope stabilization.
in terms of skills:
1. determines which geotechnical tests are most reliable for determining soil parameters;
2. determines when conditions require the use of intermediate foundations;
3. pre-assesses whether a geohazard is likely to occur under given conditions;
4. determines whether a geohazard has a natural, anthropogenic, or mixed cause.
in terms of social competences:
1. is ready to aware others of existing geohazards, including those related to interaction along the border between human and nature.
Course learning content:
Geotechnical models and their parameters (basic strength-deformation soil models, physical and mechanical parameters of soil).
Basics of geotechnical site characterization (characterization of most valuable and often used laboratory and in situ tests).
Basics of foundation and geotechnical engineering.
Influence of woodland on the buildings and structures.
Engineering solutions for soft soils (geosynthetics, building materials, constructions).
Engineering solutions for slope stabilization (slope stability analysis, reinforcement constructions).
Engineering solutions for earthquake and mining areas (geotechnical problems of earthquake and mining areas, soil liquefaction, monitoring and special solutions for risk reduction).

Course name: **Photographic documentation of natural environments**
On successful completion of this course, a student
in terms of knowledge:
1. The students understands the role of photography in geosciences, including the documentation of natural and antrophogenic environments and their transformations
2. The students knows the technical principles of nature photography, including both biotic and abiotic components of natural environments
3. The students knows the basic technical and ethical principles of image processing in nature photography
in terms of skills:
1. The student is able to accurately document natural environments, including the selection and use of specialised photographic equipment
2. The student is able to presents the results of photo-documentation in an attractive, visually compelling form, including with the use of post-production image processing
in terms of social competences:

1. The student is able to use the photography as a tool in the dissemination of the knowledge of geosciences and environmental protection, including in science popularization and communitation with non-specialists

Course learning content:
Technology and equipment
Image processing in graphical software
Role of photo-documentation in geosciences and science popularization

Course name: **Fossil record of past environmental transitions**
On successful completion of this course, a student
in terms of knowledge:
1. the student recognises the environmental background of the major transitions in the Earth history
2. the student understands the controls on the past environmental transitions, with emphasis on both the potential and limitations of different research methods

in terms of skills:
1. the student is able to interpret the present environmental changes in the context of possible past analogues

in terms of social competences:
1. the student is able to apply the knowledge of the past environmental transitions in the dissemination of scientific knowledge, tackling the environmental challenges, and increasing the awareness of the environmental problems among the general public

Course learning content:
The Earth as a system: climate vs. environment; elemental cycles; palaeogeographic constraints; environmental feedbacks, critical transitions
Proxies of the atmospheric evolution in deep time
Proxies of past temperatures
Environmental feedbacks associated with biosphere evolution
Palaeogeographic configuration as an environmental agent
Record of the human imprint

Course name: **The art of reading research papers**
On successful completion of this course, a student
in terms of knowledge:
1. knows the proper structure of a research paper.

in terms of skills:
1. develops critical and higher order thinking;
2. frames novel research questions, defines research goals and hypothesis;
3. masters of a research reading and writing skills in geosciences;
4. critically evaluates content and structure of the research papers.

in terms of social competences:
1. is prepared to efficiently communicate science in a form of both research abstract and a plain language summary.

Course learning content:
Research questions, goals and hypothesis - how to frame these?
Efficient literature reviewer - how to find a research gap in my research field?
Why we should care - what makes that research question significant?
Research methods description.
Open data and open science.
Communicating science: plain language summary and graphical abstracts.
How to discuss research results?
How to frame the conclusions in a research papers?

Course name: **Introduction to geohazards**
On successful completion of this course, a student
in terms of knowledge:
1. knows classification of geohazards and definition of various types of geohazards;
2. understands the linkage of various Earth System processes with human activity and resulting hazards and risks.

in terms of skills:

1. recognizes fundamental feedback effects and process-based relationships between various natural processes (in particular of extreme magnitude) and human activity.

in terms of social competences:

1. is ready to educate and share the knowledge on geohazards and their mitigation with wide non-academic audience and society.

Course learning content:

Presentation of the linkages between various Earth System processes and human activity, as well as the resulting hazards and risks.
Providing classification and definitions of various types of geohazards.
Description of the fundamental feedback effects and process-based relationships between various natural processes (in particular of extreme magnitude) and human activity.

Course name: **Adaptation of students to study and to do laboratory work at FGGS and AMU**

On successful completion of this course, a student

in terms of skills:

1. efficiently plans her/his work and study at the Faculty of Geographical and Geological Sciences, Adam Mickiewicz University.

in terms of social competences:

1. is prepared and willing to work within the structures of Faculty of Geographical and Geological Sciences, Adam Mickiewicz University.

Course learning content:

The higher education system in Poland - how it is organized?
The structure and infrastructure of Faculty of Geographical and Geological Sciences.

Course name: **Introduction to climate system and contemporary climate change**

On successful completion of this course, a student

in terms of knowledge:

1. knows the basic components and processes that takes place in atmosphere and its interactions to other geo-spheres;
2. knows conflicts between natural and socio-economical components that may appear in environment; broadly explains its reasons and optimal ways of resolving them;
3. understands the need of creating possible future scenarios with the role of modeling solutions for assessing potential changes in environment and its effects for socio-economic actions;
4. knows environmental problems caused by anthropopression;
5. understands and classifies global processes, including global environmental changes and its impact on physical state of different spheres that brings cause-and-effect impacts in natural and socio-economic aspects.

in terms of skills:

1. uses proper and precise vocabulary used in climate studies together with commonly applied methods to describe processes related to contemporary climate change;
2. describes reasons for temporal and spatial differentation of environmental components, including atmospheric phenomena, impacting socio-cultural and economical aspects.

in terms of social competences:

1. is aware of importance of bio- and geodiversity for including them in local, regional and global climate-related policies;
2. is prepared to apply common climate-protection rules in order to maintain ecosystem in an unchanged state for next generations.

Course learning content:

Atmosphere and its components. Significance of energy fluxes for state of atmosphere and its balance. 0-dimensional model of energy balance.
The role of greenhouse gases in shaping the radiance balance. Greenhouse gases life cycle and its global warming potential.
Carbon cycle and its role for climate system.
Basics of Global Climate Models and its structure. Climate projections. IPCC Reports.
Contemporary effects of climate change in regional and global scale. Attribution of extreme events to climate change. Adaption and mitigation policies in terms of contemporary climate change.
Geopolitics on the background of global climate changes and its socio-economic and political consequences.

Course name: **Geohazards assessment**

On successful completion of this course, a student
in terms of knowledge:
1. knows the fundamental concepts of hazard assessment and the basic definitions;
2. understands the methodology of geohazard assessment using various types of input data.
in terms of skills:
1. recognizes the limitations of geohazard assessment related to various methodologies and geohazards.
in terms of social competences:
1. is prepared to educate non-academic audience on socioeconomic importance of the geohazards assessment and is willing to share the knowledge with society.
Course learning content:
Presentation of basic concepts and definitions related to hazard assessment.
Explanation of various methodologies in geohazard assessment, depending to various input data sources (geological, historical, modeling) and type of geohazard.
Description of adavtages and limitations of various hazard assessment approaches and their implementation problems.

Course name: **Hydrological and hydrogeological hazards**
On successful completion of this course, a student
in terms of knowledge:
1. understands the influence of the natural environment and human activities on the development of hydrological and hydrogeological hazards on different scales;
2. understands an increasing role of hydrological and hydrogeological hazards in shaping the directions of socio-economic development;
3. understands the importance of risk management adaptation strategies in mitigation of the consequences of hydrological and hydrogeological hazards on different scales;
4. knows the latest scientific achievements related to the course of hydrological and hydrogeological hazards and methods of their control;
5. knows the risks associated with the presence of chemicals currently not regulated under environmental laws in surface and groundwater; understands the sources and fate of such chemicals.
in terms of skills:
1. analyzes and interprets the causes and course of hydrological and hydrogeological hazards and predicts their effects based on the obtained knowledge in the field of natural and socio-economic sciences;
2. plans solutions of risk management and mitigating the impacts of hydrological and hydrogeological hazards on the socio-economic development;
3. determines the importance of the geographical features of the catchment, climate change and human activity in shaping the spatio-temporal differentiation of hydrological and hydrogeological hazards in different geographical zones;
4. applies computer techniques (e.g. GIS software) to resolve problems related to hydrological and hydrogeological hazards.
in terms of social competences:
1. is prepared to engage in science communication, teaching and campaigns for popularization the knowledge on hydrological and hydrogeological hazards and disaster risk reduction;
2. is prepared to find solutions aiming to mitigate the impacts of hydrological and hydrogeological hazards on the socio-economic development.
Course learning content:
Introduction to hydrological and hydrogeological hazards: research subject and tasks.
Analysis of the impact of natural conditions and human activities on the course and magnitude of hydrological and hydrogeological hazards.
Case studies: hydrological and hydrogeological hazards from the local, regional and global perspectives.
The predicted directions of development of hydrological and hydrogeological hazards in the light of latest scientific achievements.
Legal aspects of the hydrological and hydrogeological hazards prediction and control.
Sources of information on hydrological and hydrogeological hazards: analysis of the hydrographic maps, the flood hazard maps and the flood risk maps.
Case study: hydrological and hydrogeological risk management.

Course name: **Skills of write-up (papers, reports, presentations)**

On successful completion of this course, a student
in terms of knowledge:
1. knows various types of research written work;
2. knows the rules and regulations associated with copyrights.
in terms of skills:
1. effectively plans the writing of various types of research texts;
2. effectively collects the necessary bibliography and critically evaluates the reliability of various sources;
3. prepares the bibliography according to various formats and in compliance with copyrights;
4. reviews and edit written research work.
in terms of social competences:
1. is better prepared to communicate in writing various research topics academic and non-academic publicity.
Course learning content:
How to look for bibliography?
Organization, managing and storing references tools.
How to check reliability of the written sources?
How to plan your write-up: strategies and tools.
How to write-up - wasy of routine.
Editing and reviewing of scientific writing - methods and tools.

Course name: **How do we talk about climate change? IPCC report case study**
On successful completion of this course, a student
in terms of knowledge:
1. knows natural and anthropogenic drivers of the climate change;
2. knows most up to date examples of study on the past and ongoing climate change.
in terms of skills:
1. differentiates between natural and anthropogenic causes of the climate change;
2. critically assesses the possible future scenarios of the climate change;
3. verifies the reliability and critically assesses various sources of information on climate change.
in terms of social competences:
1. is prepared to effectively and with respect to the opponents argue against fake news in the topic of climate change.
Course learning content:
During the course the natural cycles of the climate variability will be discussed (annual to decadal, century scale, millennial; Heinrich and Dansgaard-Oeschger Events).
The causes and mechanisms of the current climate change will be presented (particular attention will be paid to differentiation between natural and anthropogenic causes of climate variability).
Future climate scenarios will be discussed base on the analysis of the IPCC report and case studies selected from this publiaction.
Basic "fake" theories on the contemporary climate change will be reviewed and arguments oposing them will be discussed.

Course name: **Sustainable energy transition and alternative solutions**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the concept of sustainable energy transition;
2. knows and understands the idea of low carbon economy;
3. understands causes and effects of fossil-based systems of energy production and consumption on climate changes.
in terms of skills:
1. identifies the relationships between using different energy resources and their impact on climate change and human well-being;
2. identifies opportunities and limitations of using different source of energy.
in terms of social competences:
1. is prepared to take action to prevent climate change by implementing alternative solutions of energy use;
2. is prepared to take action to propose solutions for limiting energy consumption.
Course learning content:
Fossil-based systems of energy production and consumption.

Renewable energy sources.
The energy policy.
Conventional and unconventional energy resources.
Economy based on low carbon energy.
Facts and myths of green energy.
Different types of sustainable energy transition.
Limitation of energy needs and implementation to energy use behaviour.
Alternative solutions of energy use in the future.

Course name: **Advanced Scientific English**
On successful completion of this course, a student
in terms of skills:
1. can expresse in speech and writing their opinions on topics related to their specialization - present arguments and counterarguments to support their point of view;
2. can read and understand English scientific texts of an academic nature, related to the field of study; can analyze their contents and retrieve the required information;
3. can understand English audio and video materials of an academic nature, related to the field of study; can analyze their contents and retrieve the required information;
4. can jointly design and deliver presentations on chosen scientific topics related to the field of their study.
in terms of social competences:
1. is capable of designing creative multimodal campaigns and presentations aimed at reaching a wider academic and non-academic audiences in order to inform the public about the challenges related to climate change.
Course learning content:
Review and consolidation of English tenses and other complex grammatical structures at B2+ level (CEFR) that are indispensable for discussing geohazards and phenomena related to climate change.
Advanced scientific vocabualry related to geohazards and climate change.
Strategies for effective reading used to negotiate meaning of statements in scientific and specialistic texts; guessing the meaning of unfamiliar words.
Strategies for effective litening used to negotiate meaning of statements in scientific and specialistic texts; guessing the meaning of unfamiliar words.
Responding to questions, participating in discussions and debates; expressing a variety of language functions, like asking for repetition, definition, clarification, disagreeing, apologizing, etc.
Writing scientific texts related to the field of the study, e.g. eportfolios, reports, summaries or abstracts.

Course name: **Designing smart and green cities**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the concept of smart and green cities;
2. knows how to design ecological-friendly cities.
in terms of skills:
1. identifies the relationships between landscape development and its impact on environment conditions and human well-being in cities;
2. identifies opportunities and limitations of using different tools to make urban areas more comfortable for residents.
in terms of social competences:
1. is prepared to take actions to prevent the negative effects of climate change in urban areas;
2. is prepared to take actions to design ecological-and-human-friendly cities.
Course learning content:
The concept of smart and green cities.
Principles of landscape planning in green and smart cities.
Examples of ecological-friendly cities.

Course name: **Changes in plant cover in the Holocene**
On successful completion of this course, a student
in terms of knowledge:
1. knows possibilities of palaeoecological methods, their meaning in paleogeographical, geological, historical and archeological researches, special significance of pollen analysis, its advantages, limitations and fundamentals of interpretation;

2. knows basic rules of other paleoecological methods, e.g. plant macrofossils, diatoms, Cladocera, their complementary use;
3. knows methods of dating: radiometric (C14), laminated sediments, dendrochronology;
4. knows vegetation history of the late glacial and Holocene succession in Central Europe.
in terms of skills:
1. describes and interprets pollen diagram, use bioindicative value of particular taxa to discuss vegetation changes and their reasons, climatic and habitat factors, human activity and its influence on plant communities.
Course learning content:
The subject of paleoecological research. What for we do it?
Pollen analysis – the basic method of the reconstruction of paleoenvironmental conditions and ecosystems.
Other paleoecological methods, features, limits and advantages.
Chronological methods in relation to vegetation succession.
Vegetation history during the late glacial and Holocene based on some exemplary sites.
Detailed interpretation of pollen diagram: vegetation succession, regional and local differences, human impact, significance of bioindicators.

Course name: **Mitigation of social conflicts in a changing environment**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands how environmental changes influence human living conditions;
2. knows and understands the background of social conflicts from the past and contemporary perspectives.
in terms of skills:
1. identifies different social conflicts resulted from environmental changes;
2. identifies solutions for socio-environmental conflicts.
in terms of social competences:
1. is prepared to take action to solve socio-environmental conflicts;
2. is prepared to take action to be involved in decision-making process about environmental changes.
Course learning content:
Psycho-sociological perception of climate changes.
Global resources and politics.
War over water.
Human migrations – historical and contemporary approaches.
Social conflicts in various environmental conditions.
Mitigation of social conflicts: collaboration across sectors and scales.
Solving social conflicts: mediations, negotiations and public consultations.
Environmental and human impact assessment.
Public participation in the planning process – social injustice.

Course name: **Remote sensing of environmental change and geohazards**
On successful completion of this course, a student
in terms of knowledge:
1. knows the basic properties of electromagnetic radiation;
2. understands the interactions between electromagnetic radiation reaching the Earth's surface through the atmosphere and natural and anthropogenic objects and knows their spectral characteristics;
3. knows and understand the theoretical basis of obtaining remote sensing data from various levels;
4. knows what is the usefulness of different bands of the electromagnetic spectrum for the study of natural and urban environment.
in terms of skills:
1. recognizes spatial and temporal environmental changes in geohazard susceptibility based on remote sensing data;
2. monitors and assess geohazards using remote sensing methods;
3. proposes the use of appropriate remote sensing methods to solve a specific research topic related to geohazards and climate change.
Course learning content:
Physical basics of electromagnetic waves interaction with the elements of the Earth's surface, and atmospheric effects on the permeability of these waves.
Methods and instruments for acquiring airborne and satellite images.

Basic rules for the interpretation of soils, vegetation and surface waters properties from satellite and airborne images in the optical range.
Remote sensors for mapping and monitoring geohazards and climate change: SAR (Synthetic Aperture Radar) interferometry, PSI (Persistent Scatterer Interferometry), photogrammetry, LiDAR, GNSS.
The use of remote sensing techniques for monitoring and characterizing earthquakes, landslides, subsidence, floods and volcanoes, carbon dioxide storage, infrastructure stability, damage assessment, early warning.

Course name: **Wetland ecology and climate change**
On successful completion of this course, a student
in terms of knowledge:
1. knows biogeography and typology of World and European wetlands;
2. knows biodiversity of wetlands in the different spatial and temporal scales;
3. understands relationships between climate, hydrology and carbon storage in wetlands;
4. understands the loss of diversity and carbon in wetlands through human-induced disturbance, e.g. farming & forestry;
5. knows the influence of urbanization and pollution on wetland ecosystems;
6. knows the challenges connected with the conservation of wetlands.

in terms of skills:
1. assesses the significance of wetlands-climate feedback presently and in long-term perspective;
2. identifies challenges connected with the conservation of wetlands and their significance for climate and humans.

in terms of social competences:
1. is prepared to engage in scientific communication, teaching and popularisation of the wetland's sustainable management but also work for the better future of wetland ecosystems.

Course learning content:
Biogeography and typology of wetlands.
Biodiversity of wetlands: from macro to micro scale.
Hydrology and carbon in wetlands.
Disturbance: Farming, Forestry and Mining.
Wetlands and climate change: significance of global warming.
Palaeoecology, wetland archive and archaeology.
Conservation and restoration of wetlands.

Course name: **Anthropocene and ecosystems**
On successful completion of this course, a student
in terms of knowledge:
1. understands the impact of humans on ecosystems in the Anthropocene in the different time scales in the context of the ecological and climatic crisis;
2. comprehends of the solutions: ecological restoration approaches in the environment transformed by anthropogenic impact.

in terms of skills:
1. evaluates and discusses the problem of the negative impact of humans on nature in the Anthropocene as well as finding appropriate methods of ecosystem restoration.

in terms of social competences:
1. is prepared to engage in science communication, teaching and popularisation about the Anthropocene and ecological crisis.

Course learning content:
Fundamentals of Ecology (Ecosystems, Communities, Landscape).
Anthropocene in the context of past global changes, discussions about beginning of the Anthropocene.
Disturbances – Pollution, Drainage, Exploitation of natural resources.
Global warming in the Anthropocene.
Nature protection – active and passive nature conservation.
Anthrogenic biosphere: novel ecosystems and anthromes.
Ecological restoration - perspectives for the future.

Course name: **Arctic and Antarctic under climate warming**
On successful completion of this course, a student
in terms of knowledge:
1. knows the role of cryosphere in the Earth system;

2. knows the basic definitions in glaciology and glacial geomorphology;
3. knows the research methods in glaciology and can characterise them, as well as indicate advantages and disadvantages;
4. knows and is able to describe the processes within the glaciers and their interactions with various other components of the landscape and environment;
5. understands the geological and historical changes in cryosphere.

in terms of skills:

1. explains and characterises basic processes in cryosphere;
2. critically discusses the most recent predictions of changes within the cryosphere on the Earth;
3. characterizes past and contemporary geographical distribution of glaciers on the Earth;
4. ccritically assesses the information on the cryosphere changes published in media.

in terms of social competences:

1. is prepared to discuss, with respect to opponents, the fake-news on the cryosphere changes published in media.

Course learning content:

The ice in the environment. Ice-sheets and glaciers as the most important element of the cryosphere.
Ice-sheet and glaciers mass-balance - the mass and energy exchange between the ice and the atmosphere.
The temperature of the ice within the ice-sheet and glacier and its implcation for water circulation and ice-movement.
Interaction of the ice-sheets and glaciers with the hydrosphere, atmosphere and Earth surface.
The regional glaciology.

Course name: **Adaptation in the time of sea-level rise**

On successful completion of this course, a student

in terms of knowledge:

1. understands the mechanisms of short-term (seasonal and decadal) and long-term sea-level changes;
2. based on historical and contemporary examples knows what are the consequences of the sea-level change to human civilization;
3. based on historical and contemporary examples knows what are the local, regional and global adaptation strategies and what are the challenges in their implementation.

in terms of skills:

1. defines and explains the seal-level change;
2. differentiates and characterises the global and regional sea-level rise;
3. enumerates and explains factors of the sea-level rise;
4. identifies what are the consequences of the sea-level rise on local, reginal and global society;
5. identifies possible adaptation strategies of local, regional and global society to sea-level change.

in terms of social competences:

1. is prepared and has the intellectual tools to discuss the causes and effects/consequences of the global and regional sea-level rise on the local, regional and global society.

Course learning content:

The mechanisms of and differences between the short-term (seasonal, annual to decadal) and long term sea-level as well as regional and global SLR will be presented.
Various factors contributing to the SLR such as thermal expansion, non-polar glaciers, Greenland and Antarctica and mass exchange will be discussed.
The effects and threats for the local, reginal and global society associated with the changing sea-level will be presented and discussed.
The examples of historical and contemporary influence of sea-level change on the local, regional and global society will be presented and the strategies for adaptation will be discussed.

Course name: **Environmental sciences: theory, field and laboratory workshop**

On successful completion of this course, a student

in terms of knowledge:

1. understands the selected methodological foundations of the research process in Earth sciences.

in terms of skills:

1. effectively plans the research process, from the phase of desk-based literature review, through the field and laboratory work to the stage of synthesis, interpretation and discussion;
2. organizes the fieldwork in compliance with health and safety regulations;
3. organizes the laboratory work in compliance with health and safety regulations;

4. synthesizes and writes up the research results in a form of a report, research article or other selected scientific form;
5. cooperates in a group and organizes the work of a group as a leader.

Course learning content:

How to start the research: literature review and hypothesis fomulation.
Effective ways of bibliography managment: tools, techniques, pitfalls.
Desk-based study before going to the field - selected methods and techniques.
Fieldwork: planing, selection of site, permissions, preparation, health and safety.
Fieldwork - selected methods and techniques.
What is something goes wrong? Case study of successful and unsuccessful fieldwork campaings. Fieldwork crisis management.
Laboratory stage of the research - organization and health and safety. Selected methods and techniques.
Happy end - how to wrap-up and write up your research.

Course name: **Endogenic geohazards**

On successful completion of this course, a student

in terms of knowledge:

1. understands the geodynamic background of the processes related to generation of endogenic geohazards;
2. knows the reasons, mechanisms and characteritics of endogenic geohazards and describes classical examples of the related events from historic and modern times;
3. knows the modern methods of studying, monitoring and analysing endogenic geohazards, as well as the ways of preventing the risks and minimising the disastrous effects connected with them;
4. understands the interplay between the endogenic geologic hazards and surface geohazards, as well as scale of human impact on occurrence of specific endogenic geohazards.

in terms of skills:

1. analyzes the endogenic processes standing behind the development of geohazards;
2. describes the methods connected with mitigation of different types of endogenic geohazards, and to analyse the effects of application of these methods;
3. analyzes the cases of events related to specific types of endogenic geohazards based on scietific literature and data analysis;
4. draws conclusions and competently presents knowledge related to occurrence of phenomena connected with endogenic geohazards and their impact on humans.

in terms of social competences:

1. is conscious of significance of detailed and continuous research and technological efforts related to understanding of endogenic geohazards and their mitigation, with reference to the specifity of given regions on the globe;
2. appreciates the importance of the appropriate, thorough selection of topical and reliable sources knowledge and information in studying the role of geohazards and their mitigation in modern society.

Course learning content:

Geodynamic processes in the solid Earth incl. plate tectonics as a framework for understanding endogenic geological hazards.
Overview of the endogenic geohazards (their types) with reference to tectonic and magmatic processes.
Earthquake hazards – their reasons, mechanisms, diversity, related processes. Global and regional distribution of earthquakes. Examples of catastrophic earthquakes and their effects in historic and modern times.
Consequences of earthquakes for humans, their infrastructure and activity. Mitigation of the earthquake hazards: their monitoring and forecasting. Prevention/minimizing of earthquake-based damages for human society and its material wealth (constructions, infrastructure).
Volcanic hazards – their reasons, mechanisms, diversity, related processes. Global and regional distribution of volcanic eruptions. Examples of catastrophic volcanic eruptions and their effects in historic and modern times.
Consequences of volcanic events for humans, their infrastructure and activity. Mitigation of the volcanic hazards: their monitoring and prediction. Prevention/minimizing of volcanism-based damages for human society and its material wealth (constructions, infrastructure).
Isostatic movements – their reasons, mechanisms, related processes. Examples of isostatic processes and their impact on human environment and activity.

Interactions between the endogenic geohazards and surface geohazards. Role of the underground geological hazards on generation of exogenic hazardous processes (like landslides, mud flows, tsunamis, air and water pollution, temporal weather anomalies etc.).
Impact of human activity (anthropogenic phenomena) on the potential occurence and characteristics of endogenic geohazards.
Significance of development in the multidisciplanary studies of endogenic geological processes and related geohazards for the modern and future society. Overview of modern methods and techniques involved in monitoring of endogenic geohazards and their mitigation.

Course name: **Lake sediments: learning from the past**
On successful completion of this course, a student
in terms of knowledge:
1. knows methodoloigal basis for using lake sediments as paleoenvironmental archives;
2. knows the methods applied in the palaeolimnological studies of lake sediments;
3. knows basic paleolimnological therminology.

in terms of skills:
1. interprets environmental history (including some natural and anthropogenic changes) recorded in different components of lake sediments;
2. reads and understands paleolimnological journals and reference books;
3. based on a literature review student makes a presentation on a paleolimnological topic.

in terms of social competences:
1. is aware of the need to investigate the past changes of aquatic systems in the context of ongoing global environmental changes;
2. is aware of the role of palaeolimnology to define reference conditions in the aquatic systems;

Course learning content:
Methodological basis for palaeolimnology:
1. Definition of palaeolimnology.
2. How do lake sediments record environmental changes?
3. Temporal and spatial scales of palaeolimnological reconstructions.
4. Questions to be answered by palaeolimnology (climate change, vegetation change, anthropopreassure etc.).
5. Leading palaeolimnological journals.

Limnological background:
1. Origin and age of lakes.
2. Global distribution of lakes.
3. Annual cycle of limnological processes (primary productivity, water mixing, chemical changes in lake water column).
4. Sedimentary processes in lakes.
5. Classifications of lakes.

Methods used in palaeolimnology:
1. Designing of palaeolimnological investigations.
2. Coring and subsampling.
3. Sample processing.
4. Sediment dating methods (14C, 210Pb, 137Cs, OSL, varvochronology, tephrochronology, pollen dating).
5. Analyses of physical properties of lake sediments (grain size, dry/wet density, magnetic susceptibility).
6. Analyses of chemical composition of lake sediments.
7. Analyses of stable isotope composition of O, C and N in lake sediments.
8. Analyses of biofossils in lake sediments (pollen, plant macrofossils, diatoms, cladocera, chironomids).

Palaeolimnological case studies:
1. Lake sediments as archives of palaeoclimate and related phenomena (vegetation, erosion etc.).
2. Trophic changes in lakes over time and their causes.
3. Salinity changes in lakes and their relationship to sea lavel fluctuations.
4. Palaeolimnological record of environmental pollution.

Course name: **Master's degree laboratory**
On successful completion of this course, a student

in terms of knowledge:
1. knows and applies to rules and regulations of the copy rights and scientific research ethics.
in terms of skills:
1. critically assesses the sources of the information and applies peer-reviewed materials only in the dissertation;
2. undertakes peer-review process;
3. efficiently plans field, desk and laboratory work-plan.
in terms of social competences:
1. is prepared to work efficiently as a team member and a leader of the group.
Course learning content:
Data bases and other sources of Earth system information.
Selection of the reliable and relevant source of information.
Defining research gaps and addressing significant research question.
Overview of the most recent and relevant literature in the subject of the research.
Designing field, desk and laboratory research.

Course name: **Climate modeling**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the concepts used in atmospheric science regarding representation of spatio-temporal process on the Earth's surface, possibilities and limitations that it may cause for climate modelling;
2. understands vocabulary used among climate modeling community and its interdisciplinary use cases;
3. has advanced knowledge of statistics used for interpreting climate model outputs;
4. knows specialized GIS tools used for coupling global and regional climate models outputs for downscaling processes that can be utilized for environmental modeling;
5. knows and understands the latest trends in climate modeling and its practical application for studied specialization.
in terms of skills:
1. uses specialized terminology for refering and describing concepts of atmospheric modeling;
2. uses advanced research methods and research tools used in climate modeling;
3. uses mathematical and statistical methods for modeling and intepretation of a climate model output;
4. creates robust research plan while working with climate model products in accordance with commonly applied and scientifically recommended conventions;
5. correctly interprets and draw conclusions based on different climate model products that can be used in other applications;
6. describes the components of the geographic environment and can identify cause-and-relationship between them;
7. solves research problem by understanding its importance in a broader scale; understand the meaning of taken action for its own professional career.
in terms of social competences:
1. is aware of the significance of reliable data sources for critical reasoning and providing unbiased state of the art;
2. is prepared to improve professional skills and understanding of climate processes enriched by an interdisciplinary dimension.
Course learning content:
Introduction to statistical modeling in atmospheric sciences. Statistical methods: linear regression, non-linear regression, multiple regression. Interpretation of the verification measures and the overall quality of the created models. Forecasting and reconstruction possibilities based on statistical models.
A simple 0, 1 and 2 - dimensional model of Earth's energy balance budget. Application of a created model to determine the impactindividual components for near-surface atmosphere in the past and for climate change projections on a planetary scale.
The probability of extreme climate events for a given period of occurrence modeled with advanced statistical tools. Statistical modeling of extreme value distributions (EVD) based on the Fisher-Tippet family of distributuions. Its application for atmospheric-related phenomena.
Verification measure for assessing the quality of numerical and statistical simulations. Bias correction methods to reduce simulation errors inclimate model outpus.

Course name: **Modelling of geological processes**
On successful completion of this course, a student

in terms of knowledge:
1. knows the basic terms and principles of creating of geological processes modeling;
2. knows the potential of geological process modeling in scientific research and in applied applications.
in terms of skills:
1. evaluates the correctness of the methodological assumptions of the model and the limitations of the obtained results;
2. applies simple numerical models to solve geological problems;
3. works in a group on solving problems using modelling methods.
Course learning content:
Introduction of basic terms and classifications regarding model types (numerical, physical) and their basic characteristics.
The application of modeling of geological processes in practice - examples of limitations and applications.
Basics of writing a simple numerical model.
The use of simple numerical models, the selection of model boundary conditions, and the interpretation of the obtained results.

Course name: **Field courses: geohazards in times of climate change**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands how geohazards influence environment and human living conditions;
2. knows and understands how conventional and unconventional energy influences human living conditions;
3. knows and understands methods of reclamation of post-mining areas;
4. knows and understands methods of reclamation and management of post-flotation wastes.
in terms of skills:
1. identifies solutions to prevent geohazards (e.g.: landslides, floods, coastal erosion) as well as social-environmental conflicts;
2. identifies methods for reclamation of post-mining areas and post-flotation wastes.
in terms of social competences:
1. is prepared to take in practise actions to prevent geohazards;
2. is prepared to take practical actions to prevent conflicts arising from the use of conventional energy sources;
3. is prepared to take practical actions in fields of reclamation of post-mining areas and post-flotation wastes.
Course learning content:
Mass movements in coastal areas – the case study of Baltic seaside.
Geohazards of the Polish Lowland – flood environment – the case study of the Oder or Warta valley.
Mass movements in mountainous areas – the case study of Sudety Mountains.
Environmental effects of the operation of the post-flotation wastes – the case study of Żelazny Most.
Conventional energy and human-environment conflicts. Transboundary pollution and reclamation of post-mining areas – the case study of the Turoszów Basin.
Renewable energy – wind and solar power plants as alternative energy sources.

Course name: **Post-disaster reclamation**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the mechanizm of environmental degradation;
2. knows and understands the general concepts of reclamation;
3. knows various techniques using in reclamation.
in terms of skills:
1. identifies solutions for different types of environmental degradation;
2. chooses a reclamation method depending on the cause of environmental degradation.
in terms of social competences:
1. is prepared to take action to offer solutions for post-disaster reclamation taking into account needs of society.
Course learning content:
Introduction to different types of environmental hazards and degradation types.
General concepts of land reclamation. How we can select the direction of land reclamation?
Various techniques using in reclamation and criteria for their selection.

Problems with reclamation and land development in selected areas based on case studies 1.
Problems with reclamation and land development in selected areas based on case studies 2.

Course name: **Environmental geochemistry in the Anthropocene**
On successful completion of this course, a student
in terms of knowledge:
1. knows basic chemical processes in natural environment;
2. knows anthropogenic pollutants including classifications and cycling in the environment;
3. knows vocabulary linked to the Anthropocene.
in terms of skills:
1. distinguishes the Anthropocene in geological record;
2. identifies differences between natural and anthropogenically-impacted geochemical cycles of major elements.
in terms of social competences:
1. reads scientific publications in the field of Anthropocene and is open for discussions on global environmental changes and anthropogenic pollution;
2. is aware of the key role of human in ongoing global environmental changes;
3. is prepared to take measures mitigating the human impact on the environment.
Course learning content:
Principles of environmental geochemistry. Natural and anthropogenic geochemical cycles.
Types, fate and transport of pollutants.
Concept of Anthropocene and definitions; three types of anthropogenic factors sensu Waters; AME; GAEA.
Reading the environmental archives: peatlands, lakes, estuaries, marine sediments.
The synchronous and diachronous deposition of technofossils and elements - discussion about creating hypothesis and projects.

Course name: **Climate change through Earth's history**
On successful completion of this course, a student
in terms of knowledge:
1. knows how climate has changed in the Earth’s past and what were the drivers of changes;
2. knows the archives of climate change;
3. knows the dynamics of climate change in various temporal scales;
4. knows the limitations of climate reconstruction.
in terms of skills:
1. finds data on past climate change;
2. assesses the uncertainty of climate reconstruction;
3. indicates the difference between past and current climate changes.
in terms of social competences:
1. is prepared to assess the possible impact of past climate change on the environment and society;
2. is prepared to provide examples of feedback mechanisms operating in the past that can stimulate or postpone adverse effects of current climate change.
Course learning content:
Introduction to climate change in the Earth’s history.
Exemplification of the most abrupt climate changes in the Earth’s history and their effects.
Presentation of the methods used for long-term climate reconstruction.
Confrontation of the current and past climate changes.
Discussion of the current directions and challenges in the study of the past climate change.