

Partner 9
AKAKI TSERETELI STATE UNIVERSITY (Georgia)

Brief description of partner university: *Akaki Tsereteli State University (ATSU) is a multi-functional educational and scientific institution in Imereti region (western part of Georgia). ATSU contributes to the development of the city, region, and the country. Accordingly, the University assumes the importance of social responsibility and aims at promoting social-economic progress and sustainable development of the society.*

Department of Chemical and Environmental Technology of ATSU has almost 27 years experience in Environmental Sciences and Engineering education. Since 2012 in ATSU is started all three levels (Bachelor's-Master's-Doctoral Degree) of higher education programs in Environmental Engineering and Safety. The departments Staff has good experience in participating in various international, national, and local scientific projects on environmental impact assessment.

The development of the module is conditioned by the international project of "Erasmus +" "Development of Innovative Master's Program in Climate Management", in which the direction of environmental technologies of ATSU participates. Project title: Development of Innovative Master's Program in Climate Management.

The development of the module was based on:

- 1. Experience gained as a result of a given project*
 - Analysis and study of European experience in the implementation of educational and practical activities in climate management (teacher study visits to European partner universities).*
 - Analysis of curricula, courses, educational materials (textbooks, textbooks, brochures) and modern teaching methods in the Climate Management Master's program at partner universities.*
- 2. Sharing the approaches and existing expert knowledge of international and governmental organizations operating in the field of climate change.*

The module gives engineering graduates the opportunity to have the knowledge, skills and motivation to pursue a further career stage that will help them develop, plan and implement climate change mitigation and adaptation technologies.

GENERAL DESCRIPTION OF THE TRAINING MODULE

Level of study: *Master's*

Specialty: *Environmental Technologies*

Branch of knowledge: *Environmental Protection Technologies; Master of Science (MSc) Environmental Protection Technology.*

Title of Educational program: *Environmental Technologies*

Author:

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DESCRIPTION OF THE COURSE № 1

Global Warming and Climate Change

Number of ECTS credits: 4

Type of course: compulsory

Summary of the course: The aim of the course is:

- Introduce and study undergraduates on the causes of global warming and climate change, expected outcomes, current challenges, and approaches to climate change mitigation.
- Develop their ability to properly assess and analyze the issue.

Prerequisites for this course: N/A.

Competences:

- Discusses the manifestations of climate change and its consequences from a scientific point of view
- Substantiates its views on climate change adaptation and mitigation measures for different sectors of the economy and public activities
- Evaluates climate management measures and technologies using various environmental indicators
- Able to find, analyze, generalize and evaluate news in the field;
- Effectively present materials and scientific information to a wide and professional audience.- Identify, analyze, synthesize, and communicate scientific information and uncertainties for public and professional audiences
- Evaluates the peculiarities of the learning process as a result of self-assessment and self-criticism and can take into account the correct planning of the learning process.

Learning outcomes:

- Describes the manifestations of climate change and its consequences from a scientific point of view
- Describes and evaluates the role of greenhouse gases in the Earth's energy budget and climate system
- Connects and elaborates on sustainable development and climate change mitigation measures

- Draws conclusions on climate change adaptation and mitigation measures
- Critically analyzes and evaluates complex, incomplete and up-to-date information on global warming and greenhouse gases.
- Presents its own conclusions and arguments for both the academic and professional community.
- Evaluates the learning process in many ways and identifies further needs.

List of Lecture topics:

1. The scientific foundations of climate change, the earth's energy balance, and the greenhouse effect
2. Greenhouse gases and ozone depleting substances. Cumulative emissions. Greenhouse gas emission scenarios
3. Climate change risk assessment and management - modern approaches
4. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development; Mitigation pathways in line with the Paris Agreement; Indicative linkages between mitigation options and sustainable development using SDGs.
5. Ocean and Cryosphere in Climate Change
6. Climate change, land and water resources. Precipitation, sea level, soil moisture, water flows and flow in rivers.
7. Climate change and water resources in systems and sectors. Agriculture and food security, land use and forestry; Ecosystems and biodiversity; Water supply and sanitation; Economy: insurance, tourism, industry, transportation.
8. Land system change, land degradation, desertification and food security. Food system (and its relations to land and climate). Interactions between land and climate system components and models in scenario analysis.

List of practical classes, including laboratories, studios and workshops:

1. Practical work – Student expectations. Familiarity with the course syllabus, job content and specifics/
2. Seminar – What are the Impacts of 1.5°C and 2°C of Warming? What do Energy Supply and Demand have to do with Limiting Warming to 1.5°C?
3. Practical work – What are the Pathways to Achieving Poverty Reduction and Reducing Inequalities while Reaching a 1.5°C World?
4. What are the Connections between Sustainable Development and Limiting Global Warming to 1.5°C above Pre-Industrial Levels?
5. Practical work - Land-Based Carbon Dioxide Removal in Relation to 1.5°C of Global Warming. What are Carbon Dioxide Removal and Negative Emissions?
6. Practical work – Climate impacts on forest ecosystems and their pollinators, and impacts on food supply. How does climate change affect food security? How do the land and land use contribute to climate change? How does climate change affect water resources? Food loss and waste, food security, and land use.
7. Practical work - Trends of GHG emissions resulting from food systems (crops, livestock, land-based aquaculture, processed food. How can changing diets help address climate change? Do you know the climate impact of your food product?
8. Practical work - What Transitions Could Enable Limiting Global Warming to 1.5°C? Why is Adaptation Important in a 1.5°C-Warmer World?

9. Seminar – Future changes in water availability and demand due to climate change. Climate impacts on land use, food and agriculture, and related ecosystems

List of self-study topics:

1. What are the Impacts of 1.5°C and 2°C of Warming?
2. What do Energy Supply and Demand have to do with Limiting Warming to 1.5°C?
3. Future changes in water availability and demand due to climate change.
4. Climate impacts on land use, food and agriculture, and related ecosystems

DESCRIPTION OF THE COURSE №2

Climate change - risks, impacts and adaptation measures

Number of ECTS credits: 4

Type of course: compulsory

Summary of the course: The aim of the course is:

- Introduce and explore climate change and its management issues through discussion of different sectors;
- Develop their ability to properly assess and analyze the issue.

Prerequisites for this course: N/A

Competences:

- Discusses the manifestations of climate change and its consequences from a scientific point of view
- Substantiates its views on climate change adaptation and mitigation measures for different sectors of the economy and public activities
- Evaluates climate management measures and technologies using various environmental indicators
- Able to find, analyze, generalize and evaluate news in the field;
- Effectively present materials and scientific information to a wide and professional audience.- Identify, analyze, synthesize, and communicate scientific information and uncertainties for public and professional audiences
- Evaluates the peculiarities of the learning process as a result of self-assessment and self-criticism and can take into account the correct planning of the learning process.

Learning outcomes:

- Describes the manifestations and forecasts of climate change at the national level.
- Characterizes climate change adaptation measures envisaged by the National Strategy and Action Plan.
- Describes and evaluates climate change sensitivity indicators for different sectors.
- Critically analyzes and argues for measures to reduce the risks of climate change at the national and municipal levels.

- Prioritizes climate adaptation measures and technologies for different sectors.
- Presents individual presentations on adaptation measures.

List of Lecture topics:

1. Climate Change – Vulnerability and Adaptation. Sensitivity to climate change.
2. Peculiarities of Climate in Georgia. Climate change modeling and forecasting options.
3. Socio-Economic Sensitivity of Georgian Municipalities to Climate Change. Tourism, Cultural Heritage and Protected Areas – Existing Surveys and Sensitivity Indicators. Nature-based solutions.
4. Sensitivity of Agriculture and Forest Ecosystems to Climate Change – Existing Studies and Sensitivity Indicators. Nature-based solutions.
5. Sensitivity of the Energy Sector to Climate Change – Existing Studies and Sensitivity Indicators.
6. Sensitivity of the Industrial Sector to Climate Change – Existing Studies and Sensitivity Indicators.
7. Infrastructure and Municipalities Sensitivity to Natural Disasters – Existing Studies and Sensitivity Indicators
8. Sensitivity of the Social Sector to Climate Change – Existing Studies and Sensitivity Indicators.

List of practical classes, including laboratories, studios and workshops:

1. Student expectations. Familiarity with the course syllabus, job content and specifics.
2. Tourism, Cultural Heritage and Protected Areas – Recommendations for reducing socio-economic risks caused by climate change at national and municipal levels. Nature-based solutions.
3. Agricultural and forest ecosystems – Recommendations for reducing socio-economic risks caused by climate change at national and municipal levels. Nature-based solutions.
4. Energy Sector – Recommendations for reducing socio-economic risks caused by climate change at national and municipal levels.
5. Industry Sector – Recommendations for reducing socio-economic risks caused by climate change at national and municipal levels
6. Physical infrastructure and natural disasters – Recommendations for reducing socio-economic risks caused by climate change at national and municipal levels.
7. Social Sector – Recommendations for reducing socio-economic risks caused by climate change at national and municipal levels.
8. Student presentation on the topic – Prioritization of technologies and adaptation technologies for adaptation of the Black Sea coastal zone.
9. Student presentation on the topic – Prioritization of technologies and adaptation technologies for the agricultural sector. Livestock; Perennial crops. Cereal crops.

10. Student presentation on the topic – Technology Prioritization and Adaptation Technologies. To reduce the risk of natural disasters (landslides, mudslides). To reduce the risk of soil erosion (wind and water).

List of self-study topics:

1. Prioritization of technologies and adaptation technologies for adaptation of the Black Sea coastal zone.

2. Prioritization of technologies and adaptation technologies for the agricultural sector. Livestock; Perennial crops. Cereal crops.

3. Technology Prioritization and Adaptation Technologies – To reduce the risk of natural disasters (landslides, mudslides). To reduce the risk of soil erosion (wind and water).

DESCRIPTION OF THE COURSE №3

Climate change mitigation technologies

Number of ECTS credits: 4

Type of course: compulsory

Summary of the course: The aim of the course is to introduce students to and study climate change mitigation technologies

Prerequisites for this course: Course “Climate change – risks, impacts and adaptation measures”₂

Competences:

– Discusses the manifestations of climate change and its consequences from a scientific point of view

– Substantiates its views on climate change adaptation and mitigation measures for different sectors of the economy and public activities

– Evaluates climate management measures and technologies using various environmental indicators

– Able to find, analyze, generalize and evaluate news in the field;

– Effectively present materials and scientific information to a wide and professional audience.- Identify, analyze, synthesize, and communicate scientific information and uncertainties for public and professional audiences

– Evaluates the peculiarities of the learning process as a result of self-assessment and self-criticism and can take into account the correct planning of the learning process.

Learning outcomes:

– Describes ways to mitigate climate change for priority sectors.

– Discusses carbon dioxide capture and storage technologies.

– Argues the prioritization of mitigation technologies according to the relevant criteria.

– Critically analyzes and substantiates the measures / projects aimed at migration.

– Prioritizes climate mitigation measures and technologies for different sectors.

– Draws conclusions about the use of carbon dioxide capture and storage technologies.

– Effectively present materials and scientific information to a wide and professional audience.

– Evaluates the peculiarities of one's own learning process as a result of self-assessment and self-criticism and can take into account the correct planning of the learning process.

List of Lecture topics:

1. Mitigation pathways and measures in the context of sustainable development. Short- and long-term requirements of mitigation pathways. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development mitigation pathways that limit or return global mean warming to 1.5°C (relative to the pre-industrial base period 1850–1900). Geophysical Relationships and Constraints.

2. Overview of 1.5 °C Mitigation Pathways. Selection of technologies. Prioritization of technologies – process and criteria.

3. Tackling remaining emissions with carbon capture and storage. Carbon dioxide capture and storage technologies. Carbon dioxide capture processes. Geological storage. The concept of storage in the ocean.

4. Energy efficiency and deployment of renewables. Renewable energy and climate change. Prioritize technologies in the renewable energy sub-sector – solar energy, wind energy, geothermal energy, biomass. Georgia – Implemented, ongoing and planned mitigation measures in the energy sector. EU – Climate change mitigation technologies in the field of energy.

5. Clean, safe and connected mobility; Transport and climate change mitigation. Prioritize technologies in the transport sub-sector. Georgia – Implemented, ongoing and planned mitigation measures in the transport sector. EU – Climate change mitigation technologies in the field of transport.

6. Infrastructure and interconnections. Prioritize technologies in the residential and office building subsectors. Georgia - Implemented, ongoing and planned mitigation measures in the waste sector. EU – Climate change mitigation technologies in the waste management sector.

7. Bioeconomy and natural carbon sinks. Farm-based climate action; Restoring key habitats as carbon sinks. RED sustainability criteria for biofuels. Georgia – Implemented, ongoing and planned mitigation measures in the sectors of agriculture, land use and forestry. Climate change mitigation technologies in the agricultural sector.

8. Competitive industry and circular economy. Georgia – Implemented, ongoing and planned mitigation measures in the industrial sector. EU – Climate change mitigation technologies in the industrial sector. A New Industrial Strategy for Europe -2020.

List of practical classes, including laboratories, studios and workshops:

1. Student expectations. Familiarity with the course syllabus, job content and specifics.

2. Overview of Key Characteristics of 1.5 ° C Pathways. Selection of technologies. Prioritization of technologies – process and criteria.

3. carbon dioxide removal (CDR) measure. Discuss technology schemes. EC – Carbon capture and storage (CCS) Directive.

4. Prioritize technologies in the renewable energy sub-sector – solar energy, wind energy, geothermal energy, biomass. Comparative analysis of Georgia and EU approaches. EU progress towards 2020 climate and energy targets. Effects of renewable energy on GHG emissions and energy consumption.

5. Case study – Going greener aboard Gothenburg’s rapid-charge Hyper Bus.

6. Student presentations on topics: Decarbonising energy systems: Sectoral and cross-sectoral mitigation Options. Move to (near) zero emissions buildings: Efficiency and Renewable energy. Energy efficiency benefits in the Sustainable Development Scenario.

7. Case study – Bioenergy production helps conserve grasslands.

8. Promoting rewetting for mitigation.

9. Individual presentation of students about the selected project.

List of self-study topics:

1. Decarbonising energy systems: Sectoral and cross-sectoral mitigation Options.

2. Move to (near) zero emissions buildings: Efficiency and Renewable energy.

3. Energy efficiency benefits in the Sustainable Development Scenario.

4. Case study – Bioenergy production helps conserve grasslands

5. Case study – Promoting rewetting for mitigation.