



## COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
<b>Introduction to Climate Change: causes, consequences and solutions</b>	

Annotation
<p>This course provides an overview of the fundamental aspects of climate change. The course covers the scientific basis of climate change, including its causes, such as greenhouse gas emissions, and the resulting consequences, such as rising sea levels, extreme weather events, and changes in ecosystems. It also discusses the economic, social, and political impacts of climate change. The course explores the possible solutions, including mitigation, adaptation, and international cooperation as well as climate education and communication.</p>

Lecturer(s)	Department(s) where the course unit (module) is delivered
<b>Coordinator:</b> Prof. dr. Egidijus Rimkus <b>Other(s):</b> Assoc. prof. dr. Justas Kažys Gintarė Klimienė	Institute of Geosciences Faculty of Chemistry and Geosciences Čiurlionio 21, Vilnius 03101

Study cycle	Type of the course unit (module)
First cycle	General university studies

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Auditorium & on-line	Autumn	English

Requirements for students	
<b>Prerequisites:</b> English (level B2)	<b>Additional requirements (if any):</b> -

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	130	48	82

Purpose of the course unit (module): programme competences to be developed		
<p>The purpose of this course is to provide general knowledge about the physical science bases of climate change, climate in the past and in the future, the socio-economic and environmental impact, while introducing the students with climate change mitigation and adaptation measures, climate change policy and geopolitics as well as climate change communication.</p>		
Learning outcomes of the course unit (module)	Teaching and learning methods	Assessment methods
Students will gain an understanding of the scientific principles behind climate change;	Active lectures; seminars; discussions; essay writing; excursion.	Exam (2 parts) with closed-ended questions. Essay.

<p>Students will be able to identify and explain the major causes of climate change;</p> <p>Students will learn about the potential consequences of climate change as well as impacts on ecosystems and human health;</p> <p>Students will learn about climate change mitigation and adaptation;</p> <p>Students will be able to describe the role of states and International collaboration in shaping climate policy;</p> <p>Students will develop climate change communication skills.</p>		
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Content: breakdown of the topics	Contact hours						Self-study work: time and assignments		
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work	Contact hours	Self-study hours	Assignments
<p><b>1. Climate and the causes of climate variability and change.</b> Climate vs weather. Climate variability vs climate change. Paleoclimate and indicators. Natural causes of climate change. Climate change in the Holocene. Medieval Climate Optimum and Little Ice Age. Greenhouse gases and the greenhouse effect. Carbon cycle. Causes of climate change in the Anthropocene. Changes in greenhouse gas concentration. Climate pollution vs air pollution. (E. Rimkus)</p>	3						3	3	<p>Analysis of literature and materials of lecture</p> <p>EPA (2022)  <a href="http://www.epa.gov/climatechange-science">www.epa.gov/climatechange-science</a></p>
<p><b>2. Climate variations during the period of instrumental meteorological observations.</b> Brief history of meteorological measurements. Modern climate databases. Estimation of the surface air temperature of the Earth. Changes of the main meteorological elements over the measurement period. Changes in the cryosphere: snow cover, sea ice, permafrost, glaciers, ice shields. Changes in atmospheric circulation. El Nino and La Nina. Tropical cyclones. Changes in climate extremes. Regional changes in climate. (E. Rimkus)</p>	4						4	5	<p>Analysis of literature and materials of lecture</p> <p>Carbon brief (2022). Part 1. (Sections 1, 2, 5, 6, 9, 10, 11, 13,14)  <a href="https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-report-on-climate-science/">https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-report-on-climate-science/</a></p>
<p><b>3. Climate modelling and climate projections.</b> General information about climate models and their structure. Initial and boundary conditions. Positive and negative feedbacks in climate models. CMIP. Climate scenarios. Key socio-economic factors included in climate scenarios. Regional climate models. Future climate datasets (Eurocordex, KNMI). Projections of key climate indicators for the 21st century. Projected changes in climate extremes. (E. Rimkus)</p>	3						3	3	<p>Analysis of literature and materials of lecture (Sections 3, 4, 5, 6, 12, 15, 16)</p> <p>Carbon brief (2022). Part 1.  <a href="https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-">https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-</a></p>

									<a href="https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-report-on-climate-science/">assessment-report-on-climate-science/</a>	
<b>4. Changes in the hydrosphere during the measurement period and future projections.</b> Why is sea level changing? Short-term sea level fluctuations. Changes in sea level. The impact of El Nino on sea level. Tectonic movements. The Baltic Sea level change. Thermohaline circulation. Ocean acidification. Changes in terrestrial waters: rivers, lakes, groundwater and soil moisture. Water quality. Sea level rise projections. Future quantitative and qualitative changes in terrestrial waters. (E. Rimkus)	2							2	1	Analysis of literature and materials of lecture  Carbon brief (2022). Part 1. (Sections 7, 8) <a href="https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-report-on-climate-science/">https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-report-on-climate-science/</a>
<b>5. Climate change vulnerability and adaptation.</b> Definitions of uncertainty, vulnerability, sensibility. Methodology of vulnerability assessment. Climate change action planning. The role of international, national and sectoral institutions in climate change planning. Climate change mitigation vs. adaptation. Global potential of climate change mitigation and adaptation. Economical assessment of climate change adaptation measures. Cost benefit analysis. Identification and choosing of adaptation measures. International climate change adaptation initiatives. ClimateADAPT platform. Climate impacts and adaptation in different sectors: environment, agriculture, human health. (J. Kažys).	6							6	6	Analysis of literature and materials of lecture  Carbon brief (2022). Part 2. <a href="https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-on-how-climate-change-impacts-the-world/">https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-on-how-climate-change-impacts-the-world/</a>
<b>6. Climate change policy.</b> A brief history of climate change policy. IPCC. International agreements: The United Nations Framework <i>Convention on Climate Change</i> ; Kyoto Protocol; Paris Agreement. Greenhouse gas emissions trading. Bilateral transboundary agreements. European Union leadership. European Green Deal. Greenhouse gas emissions. Fossil fuels and renewable energy. Carbon sink. Climate change solutions. Mitigation and adaptation. Key mitigation measures. Geoengineering. Climate change finance. Threats posed by climate change policies. Climate justice. The global North's 'climate debt' to developing countries. (E. Rimkus)	3		3					6	6	Analysis of literature and materials of lecture, preparation for seminar  Carbon brief (2022). Part 3. <a href="https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-on-how-to-tackle-climate-change/">https://www.carbonbrief.org/in-depth-ga-the-ipccs-sixth-assessment-on-how-to-tackle-climate-change/</a>
<b>7. Climate change geopolitics.</b> Climate change as a geopolitical factor. Eurocentrism. Globalization. Global North and Global South. Industrial, green and digital revolution. Climate change and national policies. The role of states in climate change policy. Nationalism and global thinking. Business and climate change. The responsibility of multinational corporations for climate change and for climate change policy-making. Climate	3							3	3	Analysis of literature and materials of lecture  Dalby (2017); <a href="http://climatescienc.e.oxfordre.com/view/10.1093/acrefore/9780190228620.001.0001/acrefore-">http://climatescienc.e.oxfordre.com/view/10.1093/acrefore/9780190228620.001.0001/acrefore-</a>

change and security. Direct and indirect conflicts caused by climate change. Migration. Is strengthening national security a tool for adaptation to climate change? (E. Rimkus)								<a href="https://doi.org/10.1080/00396338.2020.1739945">9780190228620-e-642</a> (recommended) Lieven (2020) <a href="https://doi.org/10.1080/00396338.2020.1739945">https://doi.org/10.1080/00396338.2020.1739945</a> (recommended)
<b>8. Mindful climate action.</b> Who is responsible to solve climate change? Mindful climate action through carbon numeracy and individual carbon footprint calculation. Sustainable consumption through zero waste philosophy and minimalism. Three steps of positive sustainability: context evaluation, mindful climate action and enhancing our life quality. Basics of sustainable lifestyle. (G. Klimienė)	3		3				<b>6</b>	<b>6</b> Analysis of literature and materials of lecture, preparation for seminar  Wilby (2017) <a href="https://www.cambridge.org/core/books/climate-change-in-practice/9CC611732652419A328DFD4374D07066">https://www.cambridge.org/core/books/climate-change-in-practice/9CC611732652419A328DFD4374D07066</a>
<b>9. Climate change communication and education.</b> The role of information and education in climate change awareness and perception. Information availability and reliability. The role of media, science, government, NGOs, social networks and pop culture. Cultural differences in climate change beliefs and cognition. Geography of climate change perception. Individual response and the origins of impacts. Diversity of attitudes and social impacts. Climate change denial and scepticism. Environmental and climate change social movements. (J. Kažys)	9						<b>9</b>	<b>9</b> Analysis of literature and materials of lecture  Armstrong et al. (2018) <a href="https://www.jstor.org/stable/10.7591/j.ctv941wjn.1#metadata_a_info_tab_contents">https://www.jstor.org/stable/10.7591/j.ctv941wjn.1#metadata_a_info_tab_contents</a> (recommended)
<b>9. Thematic excursion</b> Excursion to Lithuanian objects of sustainable energy. (E. Rimkus, J. Kažys)			<b>6</b>				<b>6</b>	
<b>10. Preparation for the first part of exam</b>								<b>10</b> Analysis of literature and materials of lectures.
<b>10. Preparation of essay</b>								<b>18</b> Analysis of literature; essay writing.
<b>10. Preparation for the second part of exam</b>								<b>12</b> Analysis of scientific literature and material of lectures.
<b>Total</b>	<b>36</b>		<b>12</b>				<b>48</b>	

Assessment strategy	Weight, %	Deadline	Assessment criteria
Essay (Es)	20%	During the semester	Critical essay on proposed topic. 1500 words (Es).  Maximum number of points – 10. <b>9-10</b> Idea of essay is clear and developed. Logical structure. Analysis of reading material supports the main idea. Text is well prepared. <b>7-8</b>

			<p>Essay meets all the basic requirements. Idea of essay is clear. More or less logical structure. Some problems with text argumentation and/or clarity.</p> <p><b>5-6</b></p> <p>Idea of essay isn't very clear. Analysis of reading material is weak. Lack of coherent argumentation. There are problems with text structure and editing.</p> <p><b>4 or less</b></p> <p>Idea of essay is unclear. Essay is illogical, poorly organized and underdeveloped.</p>
First part of exam (closed-ended questions) (E1) (1-5 parts)	40 %	7 week of the semester	Maximum number of points – 10. The test result is calculated in hundredths of a unit, as a percentage expression of the maximum possible score that can be obtained during the exam.
Exam (online test with closed-ended questions) (E2) (6-9 parts)	40 %	During the session	Maximum number of points – 10. The exam result is calculated in hundredths of a unit, as a percentage expression of the maximum possible score that can be obtained during the exam.
<p>The final grade <b>G</b> is calculated as follows:  <b>G = 0,2*Es+0,4*E1+ 0,4*E2</b></p>			

Author	Year of publication	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
<b>Required reading</b>				
EPA	2022	Climate change science		<a href="https://www.epa.gov/climatechange-science">Climate Change Science   US EPA www.epa.gov/climatechange-science</a>
Carbon brief	2022	IPCC AR6 report overview		<p>Carbon brief</p> <p><a href="https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-report-on-climate-science/">https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-report-on-climate-science/</a></p> <p><a href="https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-on-how-climate-change-impacts-the-world/">https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-on-how-climate-change-impacts-the-world/</a></p> <p><a href="https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-on-how-to-tackle-climate-change/">https://www.carbonbrief.org/in-depth-qa-the-ipccs-sixth-assessment-on-how-to-tackle-climate-change/</a></p>
Wilby R. L.	2017	Climate Change in Practice: Topics for Discussion with Group Exercises		<p>Cambridge University Press</p> <p><a href="https://www.cambridge.org/core/books/climate-change-in-practice/9CC611732652419A328DFD4374D07066">https://www.cambridge.org/core/books/climate-change-in-practice/9CC611732652419A328DFD4374D07066</a></p>
<b>Recommended reading</b>				

Armstrong A. K., Krasny M. E., Schuldt J. P.	2018	Communicating Climate Change: A Guide for Educators		Cornell University Press <a href="https://www.jstor.org/stable/10.7591/j.ctv941wjn.1#metadata_info_tab_contents">https://www.jstor.org/stable/10.7591/j.ctv941wjn.1#metadata_info_tab_contents</a>
Dalby S.	2017	Climate Change and Geopolitics	Oxford Research Encyclopedia of Climate Science, (November), pp. 1–30.	<a href="http://climatescience.oxfordre.com/view/10.1093/acrefore/9780190228620.001.0001/acrefore-9780190228620-e-642">http://climatescience.oxfordre.com/view/10.1093/acrefore/9780190228620.001.0001/acrefore-9780190228620-e-642</a>
Jenkins A. L.	2011	Climate Change Adaptation: Ecology, Mitigation and Management		<a href="https://ebookcentral.proquest.com/lib/viluniv-ebooks/detail.action?docID=3018172#goto_toc">https://ebookcentral.proquest.com/lib/viluniv-ebooks/detail.action?docID=3018172#goto_toc</a>
Lieven, A.	2020	Climate Change and the State: A Case for Environmental Realism	Survival, 62(2), pp. 7–26.	doi:10.1080/00396338.2020.1739945
O'Brien K., Selboe E.	2015	The Adaptive Challenge of Climate Change		Cambridge University Press <a href="https://www.cambridge.org/core/books/adaptive-challenge-of-climate-change/3916C784C5A50EDC6E15185E0D5EB35F">https://www.cambridge.org/core/books/adaptive-challenge-of-climate-change/3916C784C5A50EDC6E15185E0D5EB35F</a>