BACHELOR 'S PROGRAMME
3rd YEAR OF STUDY, 2nd SEMESTER

COURSE TITLE	ENERGY AND CLIMATE
COURSE CODE	
COURSE TYPE	full attendance
COURSE LEVEL	1st cycle (bachelor's degree)
YEAR OF STUDY, SEMESTER	3rd year of study, 2nd semester
NUMBER OF ECTS CREDITS	4
NUMBER OF HOURS PER WEEK	4 (2 lecture hours + 2 seminar hours)
NAME OF LECTURE HOLDER	Prof. Habil. LIVIU LEONTIE
NAME OF SEMINAR HOLDER	Prof. Habil. LIVIU LEONTIE
PREREQUISITES	Advanced level of English

A COURSE-SPECIFIC COMPETENCES

Course-specific competences:

→ Application of the principles and laws of Physics in solving theoretical or practical problems (under qualified assistance conditions).
→ Explanation of the specific steps needed to develop algorithms for solving average difficulty problems.
→ Elaboration of graphs and reports for explaining and interpreting physical results obtained by statistical methods.
→ Explanation and interpretation of physical phenomena by formulating assumptions and operationalizing key concepts and proper use of laboratory equipment. Identification of Physics and Informatics methods, techniques and tools.
→ Drafting and presenting scientific reports in the field of Physics by using of new media technologies for communication.
→ Making connections between knowledge of Physics and of other domains (Chemistry, Biology, Informatics, etc.).

B LEARNING OUTCOMES

- Identification and proper use of the main laws and physical principles in a given context.
- Use of software packages for data analysis and processing.
- Solving of Physics problems in given conditions, using numerical and statistical methods.
- Application of Physics knowledge in given situations in related fields, as well as in experiments, using standard laboratory equipment.
- Communication and analysis of didactic, scientific and popularization of Physics-related information.
- Interdisciplinary approach of Physics-related topics.

C LECTURE CONTENT

- GENERAL AND SPECIFIC FEATURES OF THE EARTH'S ATMOSPHERE.
- Atmosphere as a physical system. Meteorological elements and atmospheric phenomena. Weather and climate.
- ATMOSPHERIC COMPOSITION AND STRUCTURE.
- Atmospheric layers.
- Atmospheric ozone. Water vapor.
- Suspensions in the atmosphere. Atmospheric pollution.
- ATMOSPHERIC STATICS.
- Equations of state.
- Vertical pressure variation. Barometric formulae.
- Geopotential.
- THERMAL PROCESSES IN ATMOSPHERE.
- Fundamental thermodynamic processes in the atmosphere. Dry adiabatic processes.
- THERMAL PROCESSES IN ATMOSPHERE.
- Moist adiabatic processes. Thermodynamic stability of the atmosphere.
- RADIATIVE PROCESSES IN SUN-EARTH-ATMOSPHERE SYSTEM.
- Thermal radiation. The Sun and solar constant. Diffusion and absorption of solar radiation in the atmosphere.
- RADIATIVE PROCESSES IN SUN-EARTH-ATMOSPHERE SYSTEM.
- Reflection of solar radiation. Albedo. Radiation of the Earth's surface and atmosphere.
- RADIATIVE PROCESSES. CLIMATIC EFFECTS.
- Greenhouse effect. Global climatic change (warming).
- THERMAL REGIME OF THE ATMOSPHERE.

- Temperature vertical distribution in the boundary layer. Temperature inversions in the atmosphere. Heat balance of the atmosphere Earth-atmosphere energy balance.
- WATER CYCLE IN THE EARTH-ATMOSPHERE SYSTEM.
- Phase transitions of water into the atmosphere. Water vapor tension over droplets. Condensation phenomena. Clouds and fog.
- PHYSICAL PRINCIPLES OF ENERGY PRODUCTION, TRANSMISSION AND USE.
- Energy efficiency, transmission and distribution of electricity, energy storage.
- Impact of fossil fuels.
- Nuclear power. Promise and dangers.
- Energy resources with particular reference to Romania.
- Prospects of future technological developments in energy use and production.
- RENEWABLE ENERGIES.
- Harnessing wind, solar, and geothermal energy.
- Expense and reliability/unreliability of renewable sources.
- ENERGY AND TRANSPORTATION.
- Environmental impacts of ground, maritime and air transport.
- HUMAN IMPACT ON THE EARTH'S ATMOSPHERE.
- Enhanced Greenhouse Effect. Global warming.
- A simple quantitative model of the earth's atmosphere to help understanding of climate change.

D RECOMMENDED READING FOR LECTURES

1. C. D. Ahrens, Robert Henson, Meteorology Today. An Introduction to Weather, Climate and the Environment, 12th Ed., Cengage Learning, 2019.
2. Varun Sivaram, Taming the Sun. Innovations to Harness Solar Energy and Power the Planet, MIT Press, Cambridge, 2018.
3. Peter Rez, The simple physics of energy use, Oxford University Press, Oxford, 2017.
4. F. K. Lutgens, E. J. Tarbuck, The Atmosphere. An Introduction to Meteorology, 13th Ed., Pearson
5. Education, Boston, 2016.
6. John H. Seinfeld, Spyros N. Pandis, Atmospheric chemistry and physics-from air pollution to climate climate change, 3rd ed., John Wiley & Sons, Hoboken, New Jersey, 2016.
7. Roger G. Barry, Eileen A. Hall-McKim, Essentials of the Earth's Climate System, Cambridge University Press, Cambridge, 2014.
8. Murry L. Salby, Physics of the Atmosphere and Climate, 2nd Ed., Cambridge University Press, New York, 2012.
9. Angus M. Gunn, A Student Guide to Climate and Weather, Greenwood, Santa Barbara, 2010.
10. Kyle Forinash, Foundations of Environmental Physics: Understanding Energy Use and Human Impacts, Island Press, Washington, 2010.
11. Bent Sørensen, Renewable Energy. Its physics, engineering, use, environmental impacts, economy and planning aspects, 3rd Ed., Elsevier, Amsterdam, 2004.
12. L. Leontie, Fizica Atmosferei, Ed. „Politehnium", Iaşi, 2004.
13. L. Leontie, Introducere în Fizica Atmosferei (Partea I), Ed. „Gh. Asachi", Iaşi, 2002.
14. Robin McIlveen, Fundamentals of Weather and Climate, 2nd Ed., Springer, 1992.
15. http://www.withouthotair.com/
16. https://c21.phas.ubc.ca/
17. Yatish T. Shah, Thermal Energy-Sources, Recovery, and Applications, CRC Press, Boca Raton, 2017.
18. Guido Visconti, Fundamentals of Physics and Chemistry of the Atmospheres, 2nd Ed., Springer, 2016.
19. Katharina Krischer, Konrad Schönleber, Physics of Energy Conversion, de Gruyter, Boston-Berlin, 2015.
20. Mark Diesendorf, Sustainable Energy Solutions for Climate Change, UNSW Press, Sydney, 2013.
21. Edward Aguado, James E. Burt, Understanding Weather and Climate (6th ed.), Pearson, Boston, 2013.
22. Marquita Hill, Understanding Environmental Pollution (3rd ed.), Cambridge Unversity Press, Cambridge, 2010.
23. Michael Allaby, Atmosphere: A Scientific History of Air, Weather, and Climate, Facts on File, 2009.
24. Alan Marshall and R. Alan Plumb (Eds.), Atmosphere, ocean, and climate dynamics: an introductory text, Elsevier, Amsterdam, 2008.
25. A. A. Tsonis, An Introduction to Atmospheric Thermodynamics, Cambridge University Press, Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, 2007.
26. Violeta Georgescu, Liviu Leontie, Termodinamică. Hidrodinamică. Dispersie, Ed. Tehnopress, Iaşi, 2006.

27. Violeta Georgescu, Liviu Leontie, Mardarie Sorohan, Fizică Moleculară şi Termodinamică, Ed. Univ. „Al. I. Cuza", Iaşi, 2006.
28. http://www.meteoromania.ro/
29. https://www.wmo.int/pages/index_en.html
30. http://www.noaa.gov
31. https://www.nasa.gov
32. 16. https://www.ipcc.ch

E	SEMINAR / LABORATORY CONTENT

- General and specific requirements in laboratory activity. Labor protection. Measuring instruments used in the laboratory. Measuring errors.
- Thermal transfer in the atmosphere. Study of convective heat transfer. Determination of heat transfer coefficient.
- Radiative heat transfer in the atmosphere. Experimental verification of Stefan-Boltzmann law.
- Water phase transitions in the atmosphere. Experimental determination of specific latent heat of water vaporization.
- Water phase transitions in the atmosphere. Experimental determination of the specific heat fusion of ice.
- Automatic weather station.
- Atmospheric phenomena. Severe weather episodes 1.
- Atmospheric phenomena. Severe weather episodes 2.
- Remote sensing techniques for atmosphere. Weather radar.
- Remote sensing techniques for atmosphere. LIDAR.
- Remote sensing techniques for atmosphere. Meteorological sattelite.
- Greenhouse effect and global warming 1.
- Greenhouse effect and global warming 2.
- Energy and climatic change scenarios.

F	RECOMMENDED READING FOR SEMINARS

1. 1. Elena Erhan, Meteorologie şi Climatologie Practică, Ed. Univ. "Al. I. Cuza", Iaşi, 1999.
2. 2. Greg Carbone, Laboratory Manual for The Atmosphere (F. K. Lutgens, E. J. Tarbuck, 7th ed.), Pretince Hall, New Jersey, 1998.

G	EDUCATION STYLE
LEARNING AND TEACHING METHODS	Lecture, debate, guided discovering process. Applications, guided discovering process, debate.
ASSESSMENT METHODS	Written paper Project presentations
LANGUAGE OF INSTRUCTION	English