Programul de studii: Enviromental Physics and Eco-Friendly Materials

Domeniul de studii: Fizică/Physics
Ciclul de studii: Master

Discipline obligatorii:

DI.101 Atmospheric Physics
DI.102 Ethics and academic integrity
DI.107 The climate system
DI.108 Dynamics of the Earth‘s interior and Seismology
DI.201 Meteorology / Meteorologie
DI.202 Advanced materials for environmental applications / Materiale avansate pentru aplicaţii de mediu
DI.203 Research activity / Practica de cercetare
DI.208 Elaboration of the dissertation thesis (4 weeks) / Finalizarea lucrării de disertaţie
DI.209 Research activity / Practica de cercetare

Discipline opţionale:

DO.103.1 Dispersion of Pollutants
DO.103.2 Simulation and modelling of ecological polymeric materials
DO.104.1 Ecological (friendly enviro) polymer materials
DO.104.2 Pollution with plastic materials and waste management
DO.105.1 Polymer degradation methods
DO.105.2 Renewable energy sources
DO.109.1 Radionuclides, environmental radioactivity and radioactive waste management
DO.109.2 Modeling environmental and astrophysical processes
DO.110.1 Statistical methods in Earth and Atmosphere Physics
DO.110.2 Time series analysis
DO.204.1 Environmental magnetism / Magnetism cu aplicaţii în fizica mediului
DO.204.2 Earth’s geomagnetic and gravity fields / Câmpurile geomagnetic şi gravitaţional ale Pământului
DO.205.1 Earth radiation budget / Bugetul radiativ al planetei
DO.205.2 Basics of energy audit/basics of environmental audit. Architectures and ecological houses
DO.210.1 Extreme phenomena. Meteorological and climatic risk
DO.210.2 Physical processes in clouds

Discipline facultative:

DFC.106 Volunteering
DFC.111 Volunteering
DFC.206 Volunteering
DFC.207 Physico-chemistry of the environment
DFC.211 Simulation methods, modelling for renewable and alternative energy sources
DFC.212 Volunteering

Syllabus

Academic year 2025/2026
DI.101 Atmospheric Physics

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Atmospheric Physics						
2.2. Teacher	Conf. dr. Bogdan Antonescu						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Bogdan Antonescu						
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					72
Research in library, study of electronic resources, field research					36
Preparation for practicals/tutorials/projects/reports/homework					36
Tutorat					0
Other activities					0
3.7. Total hours of individual study					144
3.8. Total hours per semester					200
3.9. ECTS					8

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge of Thermodynamics.
4.2. competences	Knowledge of using graphic representation programs and data processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy.
Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques.

Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Earth and his atmosphere	Systematic exposition - lecture. Examples.	2 Hours
Energy: Heating and cooling of the Earth and his atmosphereTemperature	Systematic exposition - lecture. Examples.	2 Hours
Temperature	Systematic exposition - lecture. Examples.	2 Hours
Humidity	Systematic exposition - lecture. Examples.	2 Hours
Condensation	Systematic exposition - lecture. Examples.	2 Hours
Atmospheric stability and cloud formation	Systematic exposition - lecture. Examples.	2 Hours
Precipitations	Systematic exposition - lecture. Examples.	2 Hours
Air pressure and wind	Systematic exposition - lecture. Examples.	2 Hours
Air masses and atmospheric fronts	Systematic exposition - lecture. Examples.	2 Hours
Extratropical cyclones. Introduction to weather forecasting	Systematic exposition - lecture. Examples.	2 Hours
Thunderstorms	Systematic exposition - lecture. Examples.	2 Hours
Tornadoes. Hurricanes	Systematic exposition - lecture. Examples.	2 Hours
Earth climate and climate changes	Systematic exposition - lecture. Examples.	2 Hours
Air pollution	Systematic exposition - lecture. Examples.	2 Hours

References:

1. Ahrens, C. G. and R. Henson, 2018: Meteorology Today–An Introduction to Weather, Climate, and the Environment. CENGAGE Learning Custom Publishing (12th edition edition), 656 pg.
2. Lackmann, G., 2011: Midlatitude Synoptic Meteorology. American Meteorological Society, 388 pg.
3. Martin, J. E., 2006: Mid-Latitude Atmospheric Dynamics. Wiley-Blackwell, 336 pg.
4. Markowski, P. and Y. Richardson, 2010: Mesoscale Meteorology in Midlatitudes, Wiley-Blackwell, 430 pg.
5. Saucier, W. J., 1983: Principles of Meteorological Analysis. Dover Publications, 438 pg.
6. Inness, P. and S. Dorling, 2013: Operational Weather Forecasting. Wiley-Blackwell, 231 pg.
7. Rauber, R.M. and S.W. Nesbitt, 2018: Radar Meteorology–A First Course. Wiley-Blackwell, 461 pg.

7.3 Practicals	Teaching techniques	Observations
Meteorological observations	Supervised practical activity.	2 Hours
Analysis of time series from the weather observation stations	Supervised practical activity.	2 Hours
Vertical sounding of the atmosphere. Thermodynamic diagrams.	Supervised practical activity.	2 Hours
Analysis of thermodynamic processes using radiosounding data. SkewT diagram	Supervised practical activity.	2 Hours

Meteorological satellites. Numerical weather prediction model	Supervised practical activity.	4 Hours
Weather forecasting using numerical weather predictions models, satellite data, and meteorological observations.	Supervised practical activity.	6 Hours
Radar meteorology. Cloud and meteorological radars	Supervised practical activity.	4 Hours
Weather forecasting using radar data. Analysis of microphysics of clouds using cloud radar	Supervised practical activity.	4 Hours
Analysis of time series of the principal air pollutants	Supervised practical activity.	2 Hours

References:

1. Ahrens, C. G. and R. Henson, 2018: Meteorology Today–An Introduction to Weather, Climate, and the Environment. CENGAGE Learning Custom Publishing (12th edition edition), 656 pg.
2. Lackmann, G., 2011: Midlatitude Synoptic Meteorology. American Meteorological Society, 388 pg.
3. Martin, J. E., 2006: Mid-Latitude Atmospheric Dynamics. Wiley-Blackwell, 336 pg.
4. Markowski, P. and Y. Richardson, 2010: Mesoscale Meteorology in Midlatitudes, Wiley-Blackwell, 430 pg.
5. Saucier, W. J., 1983: Principles of Meteorological Analysis. Dover Publications, 438 pg.
6. Inness, P. and S. Dorling, 2013: Operational Weather Forecasting. Wiley-Blackwell, 231 pg.

Rauber, R.M. and S.W. Nesbitt, 2018: Radar Meteorology–A First Course. Wiley-Blackwell, 461 pg.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- The clarity, coherence and brevity of the exposition. - Correct use of calculation models, formulas and relationships. - The ability to exemplify.	Written exam.	50%
Practical	- Knowledge and use of the experimental techniques - Interpretation of the results	Oral examination.	50%
Minimal requirements for passing the exam	Achieving a minimum grade of 5: - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions. - At least 50% in each of the criteria that determine the final grade. Obtaining a grade of 10: - In addition to the criteria for obtaining a grade of 5: - Correct resolution of all subjects. - Skills and deeply well-argued knowledge.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Bogdan Antonescu	Conf. dr. Bogdan Antonescu

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.102 Ethics and academic integrity

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Ethics and academic integrity						
2.2. Teacher	lector dr.Sanda Voinea						
2.3. Tutorials/Practicals instructor(s)							
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	verificare	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	1	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	14	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					31
Research in library, study of electronic resources, field research					15
Preparation for practicals/tutorials/projects/reports/homework					15
Tutorat					0
Other activities					0
3.7. Total hours of individual study					61
3.8. Total hours per semester					75
3.9. ECTS					3

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R10. The student/graduate knows the ethical norms and principles that regulate scientific research in the field and acquires a culture of responsibility in intellectual work.
Skills	R10. The student/graduate assimilates both the explicit norms (texts with normative value) and the implicit ones (customs and practices) that regulate academic and research conduct.
Responsibility and autonomy	R10. The student/graduate demonstrates solidarity, reactivity and support in strengthening academic integrity, demonstrating responsible and ethical behavior in scientific activities.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Moral evaluation frameworks. Fundamental concepts of ethics. Ethics and the scientific community. Criteria for moral evaluation: consequences / intentions, virtues.	Lecture. Example. Discussion.	2 Hours

Academic integrity: institutional tools. Codes and ethics commissions.	Lecture. Example. Discussion.	2 Hours
Principles of research ethics	Lecture. Example. Discussion.	2 Hours
Challenges and dilemmas in research ethics	Lecture. Example. Discussion.	2 Hours
Publication ethics: authorship and co-authorship	Lecture. Example. Discussion.	2 Hours
Access to resources (fairness and equity in academic organizations and research teams)	Lecture. Example. Discussion.	2 Hours
Deontology of teamwork in scientific research	Lecture. Example. Discussion.	2 Hours

References:

Julian Baggini, Peter S. Fosl, A Compendium of Ethical Concepts and Methods, Blackwell Publishing, 2014.

Blaxter, L, Hugh, C. Tight, L. How to research, New York, 2006

Angelo Corlett. " The Role of Philosophy in Academic Ethics", Journal of Academic Ethics, Volume 12, Issue 1, pp 1–14, 2014

Codul de etică al Universităţii din Bucureşti https://unibuc.ro/wp-content/uploads/2021/01/CODUL-DE-ETICA-SI-DEONTOLOGIE-AL-UNIVERSITATII-DIN-BUCURESTI-2020-1.pdf

Carta UNIBUC (https://unibuc.ro/wp-content/uploads/2018/12/CARTA-UB.pdf)

Joshua D. Greene, et. al. "An fMRI investigation of emotional engagement in moral judgment." Science, 2001.

Neil Hamilton. Academic Ethics, Westport: Praeger Publishers, 2002

Bruce Macfarlane. Researching with Integrity. The Ethics of Academic Enquiry, London: Routledge, 2009.

James Rachels, Introducere în Etică, traducere de Daniela Angelescu, Editura Punct, 2000.

Ebony Elizabeth Thomas and Kelly Sassi, "An Ethical Dilemma: Talking about Plagiarism and Academic Integrity in the Digital Age", English Journal 100.6, pp. 47–53, 2011

Anthony Weston, A Practical Companion to Ethics, Oxford University Press, 2011

Barrow, R., Keeney, P. (eds), Academic Ethics, New York: Routledge, 2006

Bretag, T. (ed), Handbook of Academic Integrity, Singapore: Springer, 2016

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course addresses the most discussed theoretical issues in the area of academic ethics, along with their practical implications for impact. Not only abstract arguments and positions are discussed and evaluated, but also issues related to the ethical infrastructure of academic organizations or moral decision-making tools that can be used by students in their academic work and future professional life

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	Ability to incorporate the principles of academic ethics and use the principles of academic writing	Written essay as outlined in the course requirements	100%

Minimal requirements for passing the exam	Achieving the grade of ADMISSION in the essay , attending at least 50% of the courses

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	lector dr.Sanda Voinea	

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.107 The climate system

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	The climate system
2.2. Teacher	Prof. dr. Mihai Dima
2.3. Tutorials/Practicals instructor(s)	Prof. dr. Mihai Dima

2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	72
Research in library, study of electronic resources, field research	36
Preparation for practicals/tutorials/projects/reports/homework	36
Tutorat	0
Other activities	0
3.7. Total hours of individual study	144
3.8. Total hours per semester	200
3.9. ECTS	8

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R2. The student/graduate knows the natural and anthropogenic factors that determine climate variability and change, methods for monitoring and modeling environmental parameters, as well as their effects on the environment and society. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.

Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R2. The student/graduate can critically analyze climate data to interpret the behavior of environmental systems, evaluating and interpreting parameters based on experimental and modeled data, estimating possible evolutions of the climate system. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.
Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R2. The student/graduate has the ability to plan and implement physical investigations on the environment, to interpret and use climate information in the decision-making process and to contribute to the development of solutions for adapting and mitigating the impact of climate change, effectively communicating the results within the scientific community and collaborating interdisciplinary. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
The importance of understanding the physical processes in the climate system	Systematic presentation. Examples	2 Hours
The climate system: its structure; definition of climate and of climate variability; climate variability at various time scales.	Systematic presentation. Examples	2 Hours
The observed structure of the climate system over the last century	Systematic presentation. Examples	6 Hours
Basic equation for atmosphere and ocean	Systematic presentation. Examples	4 Hours
The main cycles in the climate system: energetic, of angular momentum, hydrologic and of Carbon,	Systematic presentation. Examples	6 Hours
Interannual and decadal climate variability: the El-Nino Southern Oscillation phenomenon. The Atlantic Multidecadal Oscillation	Systematic presentation. Examples	4 Hours
Paleoclimatology: methods to reconstruct past climate variations Centennial and millennial climate variability: Dansgaard-Oeschger and Heinrich events	Systematic presentation. Examples	2 Hours
Orbital scale climate variability: glacial/inter-glacial cycles	Systematic presentation. Examples	2 Hours

References:

1. Peixoto J and Oort K., J., 1998: Physics of Climate, Ed New York, pp. 650.
2. Holton J. R., Hakim, G. J.,2013: An Introduction to Dynamics Meteorology, Academic Press, UK pp. 524.

7.3 Practicals	**Teaching techniques**	**Observations**
Visualizing climate data with GRADS (Grid Analysis Data System).	Systematic presentation. Examples. Exercises	4 Hours
Processing climate data with GRADS	Systematic presentation. Examples. Exercises	4 Hours

Inferring properties of the El Nino Southern Oscillation phenomenon from climatic data	Systematic presentation. Examples. Exercises	4 Hours
Inferring properties of the Atlantic Multidecadal Oscillation from climatic data	Systematic presentation. Examples. Exercises	4 Hours
Identifying the quasi-periodic components of climate indices using the Singular Spectrum Analysis method	Systematic presentation. Examples. Exercises	4 Hours
Identifying the quasi-periodic components of climate indices using the wavelet method	Systematic presentation. Examples. Exercises	4 Hours
Identifying the quasi-periodic components in paleoclimatic data	Systematic presentation. Examples. Exercises	4 Hours

References:

GRADS user's manual: http://cola.gmu.edu/grads/

Vauratd, R., Ghil, M., 1989: Singular spectrum analysis in nonlinear dynamics, with applications to paleoclimatic time series, Physica D: Nonlinear Phenomena.

Torrence, C., Compo, G. P., 1998: A Practical Guide to Wavelet Analysis, Bulletin of the American Meteorological Society.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Before deciding about the content of the course, given the scientific and socio-economic signnificance of the topic, the tenured teaching staff have reviewed the content of similar courses taught in foreign universities. The content of the course is aligned with the requirements for teaching and research positions in various institutions.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- clarity and coherence of formulations - suitable use of models and analitic formulas - ability to provide examples	Written examination	70%
Practical	- Knowledge about using the GRADS application - Interpreting the results	Homework during the semester	30%
Minimal requirements for passing the exam	- Achieving a minimum grade of 5 in each exam. - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions. - At least 50% in each of the criteria that determine the final grade. Obtaining a grade of 10: - In addition to the criteria for obtaining a grade of 5: - Correct resolution of all subjects. - Skills and deeply well-argued knowledge.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Prof. dr. Mihai Dima	Prof. dr. Mihai Dima

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.108 Dynamics of the Earth‘s interior and Seismology

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Dynamics of the Earth‘s interior and Seismology						
2.2. Teacher	Conf. dr. Cristian Necula						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Cristian Necula						
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	2	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	28	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/14/0

Distribution of estimated time for study	
Learning by using one’s own course notes, manuals, lecture notes, bibliography	61
Research in library, study of electronic resources, field research	31
Preparation for practicals/tutorials/projects/reports/homework	30
Tutorat	0
Other activities	0
3.7. Total hours of individual study	122
3.8. Total hours per semester	150
3.9. ECTS	6

4. Prerequisites (if necessary)

4.1. curriculum	Electricity and magnetism, solid state physics
4.2. competences	Usage of specific software packages for data analysis and processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom supplied with a projector, iinternet acces
5.2. for tutorials/practicals	Software packages (open source or licensed) to analyze seismological data, on-line access to international database, experiments in seismology and plate tectonics

6. Learning outcomes

Knowledge	R5. The student/graduate knows the physical processes that govern the internal structure of the Earth, the propagation of seismic waves, the analysis of gravitational and geomagnetic fields and their interaction with the environment. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.
Skills	R5. The student/graduate can analyze seismic, magnetic and gravimetric data, using geophysical methods and theoretical models to characterize the structure and internal evolution of the planet. The student/graduate can apply scientific methods and critically interpret experimental data obtained in the laboratory. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.

Responsibility and autonomy	R5. The student/graduate has the ability to plan and implement complex projects that integrate geophysical results in applied contexts, such as natural hazards or environmental monitoring, effectively communicating results within research teams and to decision-makers. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
1. Rheological properties of rocks. Seismic waves	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
2. Internal structure of the Earth. Global earthquakes distribution	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
3. Physical processes in the mantle and core. Fundamentals of plate tectonics	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
4. Kinematics of present day lithospheric plates. Plate tectonics and Global positioning system (GPS)	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
5. Long term kinematics of lithospheric plates. Paleoreconstruction of plate tectonics	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
6. Reference systems of the Earth. Continuum deformation of lithospheric plates	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours

References:

Butler, R.F., 1992. Paleomagnetism: from magnetic domains to geological terains, Blackwell Scientific Publications

Fowler, C.M.R., 1990. The solid Earth. An introduction to global geophysics. Cambridge University Press.

Lowrie, W., 2001. Fundamentals of Geophysics. Cambridge University Press

7.3 Practicals	Teaching techniques	Observations
1. Analysis of seismic waves, main parameters of an earthquake, global earthquakes distribution/ Analysis of marine magnetic anomalies	Supervised practical activity	6 Hours
2. Data bases in plate tectonics. Analysis of the present day plate tectonics	Supervised practical activity	4 Hours
3. Measuring the parameters of long term movements of lithospheric plates. Analysis of past lithospheric plates	Supervised practical activity	4 Hours

References:

Fowler, C.M.R., 1990. The solid Earth. An introduction to global geophysics. Cambridge University Press.

Lowrie, W., 2001. Fundamentals of Geophysics. Cambridge University Press

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops theoretical and practical competences and abilities which are important for a Master student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - appropriate use of environmental magnetism methods and concepts - ability to apply to specific examples		50%
Practical	- Application of environmental magnetism methods on a given particular data - results interpretation		50%
Minimal requirements for passing the exam	- Achieving a minimum grade of 5 in exam. - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Cristian Necula	Conf. dr. Cristian Necula

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.201 Meteorology / Meteorologie

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Meteorology / Meteorologie						
2.2. Teacher	Conf. dr. Bogdan Antonescu, CS1 Dr. Mihaela Caian						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Bogdan Antonescu						
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					47
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					94
3.8. Total hours per semester					150
3.9. ECTS					6

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge of Thermodynamics
4.2. competences	Knowledge of using graphic representation programs, data processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation.
Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials.

Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Atmospheric air parcel. Basic concepts. Atmospheric continuum. Scale analysis. The forces acting on the air parcel: pressure gradient force, gravitational force, friction force, Coriolis force.	Systematic exposition - lecture. Examples.	2 Hours
Conservation laws. The vector form of the momentum equation in the rotating Earth coordinate system. Equations of motion in spherical coordinates. Scale analysis of the equation of motion. Geostrophic and hydrostatic approximation. The continuity equation. Thermodynamic energy equation. Thermodynamics of the dry atmosphere.	Systematic exposition - lecture. Examples.	4 Hours
The fundamental system of equations in different coordinate systems. a) Basic equations in isobaric coordinates. b) Flow at equilibrium. Trajectories and current lines. c) Approximations of the wind in the atmosphere. Thermal wind.	Systematic exposition - lecture. Examples.	4 Hours
Circulation and vorticity. a) The circulation theorems: Kelvin and Bjerkness. b) The sea breeze phenomenon. c) Vorticity. Potential vorticity; d) Vorticity equations and divergences. Periodic movements in the atmosphere. a) Perturbation method. Waves properties. b) Types of simple waves. c) Rossby waves.	Systematic exposition - lecture. Examples.	6 Hours
Synoptic elements: Air masses - transformation of air masses; baric and geopotential patterns; fronts and frontogenesis.	Systematic exposition - lecture. Examples.	4 Hours
Synoptic-scale movement dynamics: The observed structure of mid-latitude synoptic systems; deducing the quasi-geostrophic system of equations.	Systematic exposition - lecture. Examples.	4 Hours
The development and movement of synoptic systems at middle latitudes: a) hydrodynamic instability; b) baroclinic instability-cyclogenesis; vertical movement in unstable baroclinic waves; c) energetics of baroclinic waves.	Systematic exposition - lecture. Examples.	4 Hours

References:
1. Holton J., 2012: An Introduction to Dynamic Meteorology. Academic Press, pp. 512.
2. Martin J., 2006: Mid- latitudine atmospheric dynamics, Ed Wiley and Sons, pp. 400.

7.3 Practicals	Teaching techniques	Observations
Meteorological information. Synoptic code: types of telegrams, coding and decoding of meteorological observation data.	Lecture. Problem solving.	4 Hours
Synoptic maps: analysis of baric formations and frontological analysis.	Lecture. Problem solving.	2 Hours
Determining the trajectories of air masses and meteograms) with the HYSPLIT 4 model.	Lecture. Problem solving.	4 Hours
Imaging: non-analytical from satellite and radar data; determination of ground temperature.	Lecture. Problem solving.	4 Hours
Objective methods for determining cyclogenesis and cyclone trajectories. The barotropic and modified barotropic model.	Lecture. Problem solving.	6 Hours
Case studies: Mediterranean and orographic cyclogenesis; cases of intense vertical descent.	Lecture. Problem solving.	2 Hours

Numerical modeling for weather forecasting: a) filtering sound and gravity waves; b) baroclinic model with two parameters; c) the numerical solution of the barotropic vorticity equation - relaxation and integration over time; d) sigma coordinate and model with two primitive equations.	Lecture. Problem solving.	6 Hours

References:

1. Holton J., 2012: An Introduction to Dynamic Meteorology. Academic Press, pp. 512.
2. Martin J., 2006: Mid-Latitudine Atmospheric Dynamics. Wiley and Sons , pp. 400.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- The clarity, coherence and brevity of the exposition. - Correct use of calculation models, formulas and relationships. - The ability to exemplify.	Written exam.	50%
Practical	Interpretation of the results	Problems solved during the tutorials	50%
Minimal requirements for passing the exam	Achieving a minimum grade of 5: - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions. - At least 50% in each of the criteria that determine the final grade. Obtaining a grade of 10: - In addition to the criteria for obtaining a grade of 5: - Correct resolution of all subjects. - Skills and deeply well-argued knowledge.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Bogdan Antonescu, CS1 Dr. Mihaela Caian	Conf. dr. Bogdan Antonescu

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.202 Advanced materials for environmental applications / Materiale avansate pentru aplicaţii de mediu

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Advanced materials for environmental applications / Materiale avansate pentru aplicaţii de mediu								
2.2. Teacher	Conf.Dr. Anca Dumitru								
2.3. Tutorials/Practicals instructor(s)	Conf.Dr. Anca Dumitru								
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA		

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					47
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					94
3.8. Total hours per semester					150
3.9. ECTS					6

4. Prerequisites (if necessary)

4.1. curriculum	Basic knowledge of Physics, Mathematics and Chemistry
4.2. competences	use of software packages for data analysis and processing

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia devices
5.2. for tutorials/practicals	Set of practical work illustrating the topics covered in the course; Consumables; Computers and software for data analysis

6. Learning outcomes

Knowledge	R3. The student/graduate knows the theoretical and practical concepts regarding the properties and functionalities of advanced materials (polymer materials, nanomaterials, hybrid composites or porous materials) for their application in environmental monitoring and remediation processes. R6. The student/graduate understands the mechanisms of pollutant transport and transformation, the sources and impact of plastic and radioactive materials, the functioning of green energy systems, as well as the methodological framework for environmental and energy audits. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis.

Skills	R3. The student/graduate can identify and analyze the characteristics of materials in relation to environmental applications, use characterization techniques and integrate these materials into sustainable technological solutions, conducting scientific research in the field of ecological materials with a focus on sustainability and reduced environmental impact. R6. The student/graduate can implement methods for analyzing the impact of pollutants and the life cycle of materials, understand the transport and transformation processes of substances in the environment, and systematically use audit techniques and strategies for sustainable resource and waste management. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests.
Responsibility and autonomy	R3. The student/graduate has the ability to plan and implement complex projects in the field of atmospheric and climatic phenomena, as well as sustainable materials designed to reduce environmental impact, effectively disseminating the results in the scientific community. R6. The student/graduate has the ability to choose optimal solutions that offer the greatest benefit in a given context, developing and implementing strategies to reduce environmental impact, reporting audit results and substantiating decisions regarding energy and ecological sustainability. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introductive information. Global challenges in the field of environmental pollution. European strategies in the field of development of advanced materials with environmental applications Implications of the use of advanced materials in environmental applications.	Lecture. Case study presentations. Discussions	4 Hours
Air pollution. Index of air quality	Lecture. Case study presentations. Discussions	2 Hours
Water resources. Water pollution. Index of water quality	Lecture. Case study presentations. Discussions	2 Hours
Soil pollution and remediation	Lecture. Case study presentations. Discussions	2 Hours
Wastewater treatment of municipal and industrial wastewater. Drinking water treatment. Environmental problems. Water treatment methods. Physical, chemical and biological processes.	Lecture. Case study presentations. Discussions	4 Hours
Classification of Advanced Environmental Materials	Lecture. Case study presentations. Discussions	2 Hours
Nanotechnology for Environemtal monitoring and remediation	Lecture. Case study presentations. Discussions	2 Hours
Adsorbent Materials for Air and Water Purification	Lecture. Case study presentations. Discussions	2 Hours
Photocatalytic Materials	Lecture. Case study presentations. Discussions	2 Hours
Materials for Renewable Energy Systems	Lecture. Case study presentations. Discussions	2 Hours
Sensors for Environmental Monitoring	Lecture. Case study presentations. Discussions	2 Hours
Application of Advanced Green Sustainable Materials for Environmental Applications. Circular Economy Approaches	Lecture. Case study presentations. Discussions	2 Hours

References:

7.3 Practicals	Teaching techniques	Observations
Presentation of the practical work. Training for laboratory work and safety	Lecture	2 Hours
Synthesis of advanced materials based on carbon nanotubes, graphene, nano-oxides (TiO_2, Fe_3O_4, etc.) and their performance as adsorbent materials for various pollutants.	practical activity	10 Hours
Electrochemical behavior of carbon-based materials in different environment	practical activity	8 Hours
Electrochemical sensors based on conducting polymers and carbon nanomaterials	practical activity	8 Hours
References:		

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and terminology used in the area of advanced materials and environmental applications - ability to indicate/analyze specific examples	Oral examination	70%
Practical	- ability to use specific experimental methods/apparatus - ability to analyse and interpret the characterization data - ability to present and discuss the results	Examination of Lab reports	30%
Minimal requirements for passing the exam	correct use of knowledge and terminology used in the area of advanced materials and environmental applications		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf.Dr. Anca Dumitru	Conf.Dr. Anca Dumitru

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.203 Research activity / Practica de cercetare

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Research activity / Practica de cercetare						
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic						
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	0	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	0	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/0/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	100
Research in library, study of electronic resources, field research	50
Preparation for practicals/tutorials/projects/reports/homework	50
Tutorat	0
Other activities	0
3.7. Total hours of individual study	200
3.8. Total hours per semester	200
3.9. ECTS	8

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge from previously studied courses.
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.

Skills	R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.
Responsibility and autonomy	R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course meets the current national and international requirements for the development of practical skills in higher education. Internships will be carried out in laboratories, research institutes, or companies that have established collaboration agreements for student practice. The targeted fields of activity are diverse, with potential employers ranging from educational to research and development environments.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Project	The evaluation is carried out in accordance with the faculty's internship regulations, based on an internship report prepared by the student during the activity and the assessment of the internship supervisor.	Colloquium	100%
Minimal requirements for passing the exam	To obtain a grade of 5: • Completion of all activities during the internship period To obtain a grade of 10: • Strongly reasoned skills and knowledge • Demonstrated ability to analyze phenomena and processes • Personal approach and interpretation • Correct resolution of all assigned topics		

Date, 13.07.2025	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature Conf. Dr. Cătălin Berlic

Date of approval 15.07.2025	Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.208 Elaboration of the dissertation thesis (4 weeks) / Finalizarea lucrării de disertaţie

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Elaboration of the dissertation thesis (4 weeks) / Finalizarea lucrării de disertaţie						
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic						
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	colocviu	2.7.Classification	

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/4/0
3.4. Total hours per semester	40	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/40/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					43
Research in library, study of electronic resources, field research					21
Preparation for practicals/tutorials/projects/reports/homework					21
Tutorat					0
Other activities					0
3.7. Total hours of individual study					85
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Completion of courses from the first and second year curriculum
4.2. competences	Knowledge of physics, mathematics, programming languages and numerical methods

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society. R10. The student/graduate knows the ethical norms and principles that regulate scientific research in the field and acquires a culture of responsibility in intellectual work.
Skills	R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner. R10. The student/graduate assimilates both the explicit norms (texts with normative value) and the implicit ones (customs and practices) that regulate academic and research conduct.

Responsibility and autonomy	R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers. R10. The student/graduate demonstrates solidarity, reactivity and support in strengthening academic integrity, demonstrating responsible and ethical behavior in scientific activities.

7. Contents

7.3 Practicals	**Teaching techniques**	**Observations**
In accordance with the research topic chosen for the dissertation. The topics will be aligned with subjects of interest in the field of environmental physics and eco-friendly materials.	Guided activity	40 Hours
References:		

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The discipline develops studentsţ abilities to model, to make experiments, to investigate environmental phenomena, in order to integrate them in the activities of collaborating research institutions. This provides a good scientific background which facilitates students integration in the working market and also provides the possibility to continue the studies in the doctoral program.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Practical	- Attendance at all research activities - The application of specific methods of solving the given problem; - Interpretation of results; - The clarity, coherence and brevity of the exposition	Colloquium - Oral examination	100%
Minimal requirements for passing the exam	• Mandatory attendance at all research activities • Preparation of the dissertation thesis		

Date, 13.07.2025	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature Conf. Dr. Cătălin Berlic
Date of approval 15.07.2025		Head of department name and signature Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DI.209 Research activity / Practica de cercetare

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Research activity / Practica de cercetare						
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic						
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	colocviu	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	8	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/8/0
3.4. Total hours per semester	80	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/80/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					210
Research in library, study of electronic resources, field research					105
Preparation for practicals/tutorials/projects/reports/homework					105
Tutorat					0
Other activities					0
3.7. Total hours of individual study					420
3.8. Total hours per semester					500
3.9. ECTS					20

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge from previously studied courses.
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.

Skills	R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.
Responsibility and autonomy	R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

7.3 Practicals	**Teaching techniques**	**Observations**
Research activities specific to the fields of environmental physics and eco-friendly materials	Guided activity	80 Hours
References:		

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The course meets the current national and international requirements for the development of practical skills in higher education.
Internships will be carried out in laboratories, research institutes, or companies that have established collaboration agreements for student practice. The targeted fields of activity are diverse, with potential employers ranging from educational to research and development environments.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Practical	The evaluation is carried out in accordance with the faculty's internship regulations, based on an internship report prepared by the student during the activity and the assessment of the internship supervisor.	Colloquium	100%

Minimal requirements for passing the exam	To obtain a grade of 5: • Completion of all activities during the internship period To obtain a grade of 10: • Strongly reasoned skills and knowledge • Demonstrated ability to analyze phenomena and processes • Personal approach and interpretation • Correct resolution of all assigned topics

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025		Conf. Dr. Cătălin Berlic

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.103.1 Dispersion of Pollutants

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Dispersion of Pollutants
2.2. Teacher	Lector Dr. Gabriela Iorga
2.3. Tutorials/Practicals instructor(s)	Lector Dr. Gabriela Iorga

2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	60
Research in library, study of electronic resources, field research	30
Preparation for practicals/tutorials/projects/reports/homework	29
Tutorat	0
Other activities	0
3.7. Total hours of individual study	119
3.8. Total hours per semester	175
3.9. ECTS	7

4. Prerequisites (if necessary)

4.1. curriculum	Fluid Mechanics, Thermodynamics, Notions of mathematics and chemistry
4.2. competences	Knowledge and practical capabilities of using the computer - Use of software packages for data analysis and processing

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment, white/black board and with internetconnection, possibility of multiplying didactic materials in advance
5.2. for tutorials/practicals	Laboratory with modern equipment that allows performing fundamental experiments: samplers, ceilometer, meteorological station; Computers and acquisition interfaces enabling computer-aided experiments; Access to the equipment for air sampling (gases, aerosols) and to databases with atmospheric observations; Specialized calculation programs (licensed or open source) for determining pollutant concentrations in the atmosphere and/or deposited on the land surface, trajectories of air masses, various Excel spreadsheets for the study of pollutant dispersion in different conditions of atmospheric stability/instability, for determining the height of the atmospheric mixture layer of pollutants.

6. Learning outcomes

Knowledge	R6. The student/graduate understands the mechanisms of pollutant transport and transformation, the sources and impact of plastic and radioactive materials, the functioning of green energy systems, as well as the methodological framework for environmental and energy audits. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis.

Skills	R6. The student/graduate can implement methods for analyzing the impact of pollutants and the life cycle of materials, understand the transport and transformation processes of substances in the environment, and systematically use audit techniques and strategies for sustainable resource and waste management. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests.
Responsibility and autonomy	R6. The student/graduate has the ability to choose optimal solutions that offer the greatest benefit in a given context, developing and implementing strategies to reduce environmental impact, reporting audit results and substantiating decisions regarding energy and ecological sustainability. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Pollution versus air quality. Sources and types of pollutants. Different classifications. Main and secondary gaseous pollutants and particulate matter (PM2.5, PM10, PM4, PM1); physical and chemical properties. Air quality monitoring. Measurement methods and techniques (in situ and remote sensing).	Lecture, description, explanation, conversation, debate	4 Hours
Settling particles. Dry deposition and wet deposition. Processes and methods for monitoring of depositions. Deposition simulation models.	Lecture, description, explanation, conversation, debate	2 Hours
Legislation regarding ambient air quality in the world, in the European Union and in Romania. Environmental pollution monitoring programs and intensive measurement campaigns. Differences between monitoring and intensive campaign; examples and case studies.	Lecture, description, explanation, conversation, debate	2 Hours
Planetary boundary layer PBL: Definition and meaning. Structure. Quantities that characterize PBL: wind, temperature, humidity, mixing height; thermal inversions; the stability/instability of the atmosphere in the PBL. Methods for determining PBL characteristics. The influence of PBL characteristics on the dispersion of pollutants. The ventilation coefficient.	Lecture, description, explanation, conversation, debate	6 Hours
The theoretical basis of pollutant dispersion. Lagrange and Euler formalisms, the diffusion equation and its solutions. The Gaussian equation of the pollutant plume.	Lecture, description, explanation, conversation, debate	6 Hours
Dispersion models at the local scale. Dispersion parameters. Stability classes. The rise of the pollutant plume. Examples of models - comparison of the physical and chemical schemes implemented.	Lecture, description, explanation, conversation, debate	5 Hours
The effects of air pollution. Water and soil quality monitoring. Sources of pollution and types of water and soil pollutants. Physical, chemical and biological characteristics of water. Sampling and monitoring methods. The AirQ+ model for studying the health risk assessment of pollutants	Lecture, description, explanation, conversation, debate	2 Hours
International cooperation and scientific progress regarding research and reduction of environmental pollution.	Lecture, description, explanation, conversation, debate	1 Hour

References:

1. Nitu, C, Krapivin, V.F., Soldatov, V.Y., Information technologies for the environmental investigations, Matrix Rom, Bucuresti, 2013.
2. Seinfeld, J.H. and Pandis, S.N., Atmospheric Chemistry and Physics. From air pollution to climate change, John Willey and Sons Inc., USA, 2006.
3. Iorga G, 2016, Air Pollution Monitoring: A Case Study from Romania, in Air Quality - Measurement and Modeling, Prof. Philip Sallis (Ed.), InTech, DOI: 10.5772/64919.
4. Iorga G., 2021,) "Air pollution and environmental policies, EU and Romania: where we stand, what the data reveals, what should be done in the future?", Book Chapter (23 pg) in Todor, A. and Helepciuc, F.E. (Eds.) "Europeanization of Environmental Policies and their Limitations: Capacity Building", Springer Nature Switzerland AG, Cham., ISBN 978-3-030-68585-0, https://doi.org/10.1007/978-3-030-68586-7_4.
5. Colls, J., Air pollution, 2nd Ed, Taylor § Francis e-Library, 2003.
6. Cheremisinoff, N., P., Handbook of air pollution prevention and control, Elsevier, MA, USA, 2002
7. Jacobson, M. Z., Atmospheric pollution: history, science and regulation, Cambridge Univ. Press, Cambridge UK, 2002
8. Jacobson, M. Z., Fundamentals of atmospheric modelling, 2nd Ed., Cambridge Univ. Press, Cambridge UK, 2005
9. Hernandez-Soriano, M.C.(Ed.), Environmental Risk Assessment of Soil Contamination, Intech, 2014.
10. Talpos, S., Borşan, D.H., Fizica stratului limita şi poluarea aerului, Ed. Univ. Buc., Bucuresti, 1997.
11. Various web sites of dedicated research platforms and scientific (original research or review) papers indicated by the professor during the lectures.

7.3 Practicals	**Teaching techniques**	**Observations**
Air sampling methods. Determination of pollutant concentrations using gas detectors and samplers for material particles PM10, PM2.5, PM4, PM1, CO, SO2, NOx, O3 gases.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours
Analysis of observations on pollutants and meteorological parameters over a short and long period of time (calculation of daily, monthly and annual averages and associated standard deviations, pollutant correlations - meteorological variables, graphical representations and their interpretation). Chemometeogram. Interpretation of results.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	3 Hours
Obtaining the trajectories of air masses in a given place in Romania and Europe for a time interval of up to 3 days with dedicated software, accessible via the internet.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours
Determining the height of the atmospheric boundary layer/mixing layer with the HYSPLIT model and with the help of the ceilometer. Comparison with BLH values from ERA5 reanalysis database of ECMWF.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours
Modeling the dispersion of pollutants in the atmosphere with dispersion models in various conditions of atmospheric stability/instability (simple Gaussian model, HYSPLIT, FLEXPART, etc.). Sensitivity studies regarding the input parameters of the models. Interpretation of results. Experimental and modeling studies of the deposition of fine particles. Case studies: dry deposition and wet deposition of pollutants. Interpretation of results.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	10 Hours
Determination of some physical-chemical parameters (temperature, humidity, pH, permittivity, conductivity, concentrations of the main ionic species, depth and surface water flow) of some water samples: from precipitation, lake water, river water. Determination of some physical-chemical parameters of soil samples: temperature, humidity, permittivity, conductivity, pH, granulometry, concentrations of the main metals. Correlations with observations on precipitation and atmospheric deposition.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	3 Hours

References:
1. ***Climate of Romania, Coordinators: Sandu I., Pescaru, V.I., Poiana, I., Geicu, A., Candea, I., Tastea, D., Ed. Romanian Academy, Bucharest, Romania, 2008 2. Websites of Agencies Providing Methods and Guidelines Related to Environmental Monitoring: The U.S. Environmental Protection Agency (USEPA) USAWebsite: www.epa.gov/ The International Standards Organization (ISO) Switzerland Website: www.iso.ch/ The French Association for Normalization (FAN or AFN) France Website: www.afnor.fr/ 3. Scientific articles published in main-stream journals and specific interactive applications, either accessible via the INTERNET, or usable stand-alone in the laboratory, together with explanatory notes/user manuals of the equipment used (available in the laboratory).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the contents, the choice of teaching/learning methods, given the particular importance of the discipline for applications using modern technology, the leader of the discipline consulted the content of similar disciplines taught at universities in the country and abroad. The content of the discipline is according to the requirements for employment in research institutes in atmospheric physics working groups and in education.

• The discipline meets the current requirements of development and evolution on a national and international level of higher education in the field of environmental sciences. The curriculum of the discipline is adapted to the level of knowledge and the current requirements of scientific research and technological activities, being correlated with similar study programs from European universities that apply the Bologna system. Master's students will have the necessary work skills to approach an interdisciplinary study in environmental sciences. The skills acquired by mastering the subjects covered in this course ensure an easier integration of graduates in mixed work groups. The master's students are provided with adequate competences with the needs of the current qualifications, a scientific and technical training corresponding to the master's level, which will allow them to be quickly inserted on the labor market after graduation (the fields of activity targeted are multiple, the possible employers being both from the educational area, research and development area, as well as from the industrial field, but also have the possibility of continuing studies through doctoral programs.

METHODOLOGICAL REMARKS • At each course session, the student will receive material containing schemes/diagrams, examples, stages of calculation procedures that will be explained in detail by the professor in his lecture. The interactive professor-student dialogue will represent the assurance that the students have clarified the concepts addressed. • For each topic addressed in the laboratory, the students will work as much as possible in groups of a maximum of two, under the direct guidance of the professor. The professor checks, interprets and discusses the results with each work subgroup separately, at the end of each work session. • The professor helps the students in preparing the material for the exam. Students can ask questions or discuss aspects addressed in the course or laboratory during the additional consultation hours, the schedule of which is made by mutual agreement between the professor and the student. • Attendance at lectures and practical activities is an essential condition for the good performance of the entire educational activity, so it is recommended to students to attend all classes. The material required for the exam will be presented, discussed in classes and laboratories/seminars. The wrong information about the discussions at the course/seminar/laboratory or the lack of it, the lack of materials necessary for the preparation for knowledge verifications and exams cannot be invoked by absence from the course. The listed references include at least all the subjects covered in the course and laboratory/seminar, for deepening some subjects according to the interest of each student. • Students' participation during the lectures is necessary because a dialogue helps them to better understand the concepts taught, to use an appropriate vocabulary, it creates the possibility of maintaining an interactive dialogue, as well as integration in the academic conduct. For an active presence in the course and laboratory, students are asked to review the material presented in the previous courses and laboratories. By participating in this course, the student agrees to accept the code of academic conduct presented in the University Charter, the Code of Ethics and the Regulation regarding the professional activity of students. The code prohibits students from copying and other forms of exam cheating, plagiarizing papers, presenting fraudulent documents and forging signatures.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- The clarity, coherence and the precision of the reasoning of an answer; - Correct use of concepts, laws, models, formulas and relationships; - The ability to exemplify;	Written exam and oral assessment	50%
Tutorial	- Completing laboratory assignments with an active attitude; - Knowledge and use of experimental techniques; - Good quality of the interpretation of the results.	Oral examination	50%
Minimal requirements for passing the exam	Attendance: attendance at a minimum of 50% of the number of course hours and mandatory attendance at all laboratory/seminar sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Lector Dr. Gabriela Iorga	Lector Dr. Gabriela Iorga

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.103.2 Simulation and modelling of ecological polymeric materials

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Simulation and modelling of ecological polymeric materials						
2.2. Teacher	Conf. Dr. Cătălin Berlic						
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic						
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					60
Research in library, study of electronic resources, field research					30
Preparation for practicals/tutorials/projects/reports/homework					29
Tutorat					0
Other activities					0
3.7. Total hours of individual study					119
3.8. Total hours per semester					175
3.9. ECTS					7

4. Prerequisites (if necessary)

4.1. curriculum	Real and complex analysis, Physical data processing and numerical methods, Thermodynamics and statistical physics
4.2. competences	Good level of understanding of thermodynamics and statistical physics. Notions of mathematical analysis. Ability to use the computer.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment (Computer, video projector, internet connection); Course notes; Recommended bibliography
5.2. for tutorials/practicals	Laboratory with the equipment necessary to carry out practical work: computer, video projector, software packages, internet connection. Seminar room

6. Learning outcomes

Knowledge	R3. The student/graduate knows the theoretical and practical concepts regarding the properties and functionalities of advanced materials (polymer materials, nanomaterials, hybrid composites or porous materials) for their application in environmental monitoring and remediation processes. R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society.

Skills	R3. The student/graduate can identify and analyze the characteristics of materials in relation to environmental applications, use characterization techniques and integrate these materials into sustainable technological solutions, conducting scientific research in the field of ecological materials with a focus on sustainability and reduced environmental impact. R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner.
Responsibility and autonomy	R3. The student/graduate has the ability to plan and implement complex projects in the field of atmospheric and climatic phenomena, as well as sustainable materials designed to reduce environmental impact, effectively disseminating the results in the scientific community. R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
1. Introduction. Overview of ecological polymers and their significance. The role of computer simulation in polymer science, particularly in the field of ecological polymers. Types of problems addressed by simulation. Modeling techniques. Algorithms. Limitations of computer simulations. Computer simulation and modeling as a tool for investigating the behavior of ecological polymers.	Systematic exposition – lecture, demonstration, discussions, case studies. Examples	2 Hours
2. Boundary conditions. Solving problems related to computing system memory and runtime. Free boundary conditions. Constrained boundary conditions. Periodic boundary conditions. Handling boundaries in simulations.	Systematic exposition - lecture. Case studies. Examples	2 Hours
3. Interaction potentials used in the simulation and modeling of ecological polymers. The Hamiltonian of a system of particles. Types of interaction potentials between particles: hard sphere potential, potential well, Lennard-Jones potential, Morse potential. Use of reduced measurement units.	Systematic exposition - lecture. Examples.	4 Hours
The link between computer simulations, statistical physics and polymer physics. The types of simulations that can be performed using usual statistical ensembles: Monte Carlo simulations and molecular dynamics simulations. Truncation of interaction potentials. Determining the quantities of interest of polymers as averages over statistical ensembles. Statistical fluctuations	Systematic exposition - lecture. Examples.	2 Hours

5. Organization of a simulation program in polymer physics. The building blocks. Initialization of the program and the need to equilibrate the system. Special problems related to the initialization of a molecular dynamics simulation. Error estimation. Correction of the results. Treatment of long-distance interaction forces. Data analysis. Improvement proposals of the algorithms used for the modeling of environmentally friendly polymers.	Systematic exposition - lecture. Examples.	2 Hours
6. Monte Carlo methods. Monte Carlo integration. Generating random numbers and testing random number generators. Metropolis method. The basic algorithm of a Monte Carlo simulation.	Systematic exposition - lecture. Examples.	4 Hours
7. Lattice models used in the physics of ecological polymers. Streamlining Monte Carlo simulations by using lattice methods. Limitations of the lattice methods. The basic algorithm of a Monte Carlo simulation in the lattice case for polymer molecules. The random walk problem. Diffusion. Application to the diffusion of pollutants. Surfactants. Determination of mean square end-to-end distance and radius of gyration.	Systematic exposition - lecture. Examples.	4 Hours
8. Specific algorithms for the simulation of polymeric chains: reptation, bond length fluctuation, the generalized Verdier-Stockmayer algorithm and the pivot algorithm. The bond length fluctuation method. Determination of mean square stretching and radius of gyration in the case of linear polymers. Simulation of comb-shaped and star-shaped polymers. Their role as biosensors.	Systematic exposition - lecture. Examples	4 Hours
9. Continuous models. Algorithms specific to continuous models. Monte Carlo simulations of polymers in NVT and NPT ensembles. The chain model with free joints. Pearl necklace model. The bead-spring model.	Systematic exposition - lecture. Examples	4 Hours

References:

1. D. Marenduzzo, "Introduction to Computational Polymer Physics", Cambridge University Press, 2020;
2. D. Frenkel, B. Smit, "Understanding Molecular Simulations. From Algorithm to Applications.", Academic Press, New York, 2002;
3. M.P. Allen, D.J. Tildesley, "Computer Simulation of Liquids", Oxford University Press, 1989;
4. D. P. Landau, K. Binder, "A Guide to Monte Carlo Simulations in Statistical Physics", Cambridge University Press, 2000;
5. P. Pasini, C. Zannoni, S. Žumer (Eds.), Computer Simulations of Liquid Crystals and Polymers, Kluver Academic Publishers, Dordrecht (2005).

7.3 Practicals	Teaching techniques	Observations
1. Installing Python, Jupyter or Visual Studio Code; Collaboratory. Writing and running first Python script.	Guided practical work	2 Hours
2. Introduction to Python Programming I. Python syntax and structure. Variables, basic data types (int, float, str, bool). Simple input and output. Arithmetic operations. Writing basic Python scripts: variables and simple expressions, calculations and printing.	Guided practical work	2 Hours
3. Introduction to Python Programming II. Lists, tuples, and dictionaries. Conditional statements (if/else). Loops (for, while). Functions: definition, calling, parameters. Writing Python scripts: Creating and manipulating lists. Writing loops for repetitive calculations. Defining and calling simple functions.	Guided practical work	4 Hours
4. Introduction to Python Programming III and Scientific Python. Introduction to NumPy arrays. Basic array operations. Simple data visualization with Matplotlib. Reading and writing files.	Guided practical work	2 Hours

5. Python Programming IV: Modular Programming, Logic, and Plotting. Structuring code using functions and modules. Controlling program logic. Handling data sequences. Visualizing data clearly and effectively.	Guided practical work	2 Hours
6. Monte Carlo estimation of pi using uniform random sampling. Stochastic techniques for estimating definite integrals. Estimate area under irregular shapes. Importance Sampling	Guided practical work	4 Hours
7. Simulation of the random walk of a particle in a 3D cubic lattice with free and periodic boundaries. Simulation of a simple polymer chain on a lattice with free and periodic boundaries. Self Avoiding Random Walk v.s. Simple Random Walk for a polymeric chain. Calculation of mean square end-to-end distance and radius of gyration.	Guided practical work	4 Hours
8. Simulation of a linear chain where bond lengths are allowed to fluctuate within a range. Pivot algorithm for conformation updates. Structural analysis: end-to-end distance and radius of gyration. Generate and visualize comb-shaped and star-shaped polymers.	Guided practical work	4 Hours
9. Free joint chain model. Simulation of a polymer chain using the pearl-necklace model. Monte Carlo simulation of the bead-spring polymer model	Guided practical work	4 Hours

References:

1. D. Frenkel, B. Smit, "Understanding Molecular Simulations. From Algorithm to Applications.", Academic Press, New York, 2002;
2. M.P. Allen, D.J. Tildesley, "Computer Simulation of Liquids", Oxford University Press, 1989;
3. M. Newman, "Computational Physics with Python", Cambridge University Press, 2023 (2nd edition).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Knowledge of fundamental concepts in computer simulations of polymers; - Accurate acquisition and understanding of the topics covered in the course; - Demonstration of theoretical concepts using correct computational formulas; - Clarity, coherence, and conciseness of the presentation; - Correct use of the studied physical models, formulas, and computational relationships; - Ability to provide relevant examples; - Ability to apply acquired knowledge to solve practical problems.	1. Mid-term examination. Theoretical knowledge checking-oral exam. 35% 2. Final examination. Oral theoretical knowledge exam. 35%	70%

Practical	- Knowledge and correct use of specific programming techniques - Data processing and analysis abilities; - Writing short pieces of code related to algorithms and models.	Oral examination	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions. At least 50% achievement in each of the criteria that determine the final grade.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. Dr. Cătălin Berlic	Conf. Dr. Cătălin Berlic

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.104.1 Ecological (friendly enviro) polymer materials

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Ecological (friendly enviro) polymer materials
2.2. Teacher	Lector. Dr. Eduard Gâtin
2.3. Tutorials/Practicals instructor(s)	Lector. Dr. Eduard Gâtin

2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	2	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	28	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/14/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	49
Research in library, study of electronic resources, field research	24
Preparation for practicals/tutorials/projects/reports/homework	24
Tutorat	0
Other activities	0
3.7. Total hours of individual study	97
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	Mechanics, Thermodynamics and statistical physics, Physical chemistry.
4.2. competences	Good level of understanding of mechanics, statistical physics and thermodynamics. The ability to use laboratory equipment correctly.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment (Computer, video projector). Course notes. Recommended bibliography.
5.2. for tutorials/practicals	Laboratory with the equipment necessary to carry out practical work Computer, Video projector, software packages for data analysis and processing. Internet connection

6. Learning outcomes

Knowledge	R3. The student/graduate knows the theoretical and practical concepts regarding the properties and functionalities of advanced materials (polymer materials, nanomaterials, hybrid composites or porous materials) for their application in environmental monitoring and remediation processes. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society.

Skills	R3. The student/graduate can identify and analyze the characteristics of materials in relation to environmental applications, use characterization techniques and integrate these materials into sustainable technological solutions, conducting scientific research in the field of ecological materials with a focus on sustainability and reduced environmental impact. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner.
Responsibility and autonomy	R3. The student/graduate has the ability to plan and implement complex projects in the field of atmospheric and climatic phenomena, as well as sustainable materials designed to reduce environmental impact, effectively disseminating the results in the scientific community. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. Introduction. Definition of polymers. Macromolecular systems. Physical-chemical and structural peculiarities of polymers.	Systematic exposition - lecture. Case studies. Examples	2 Hours
2. Classification of macromolecular compounds. Carbocatene organic polymers. Saturated hydrocarbons and their derivatives: polyalcohols, polyacids, polyethers, polyesters. Unsaturated hydrocarbons and their derivatives. Heterochain organic polymers: with oxygen, with nitrogen, with sulfur in the chain.	Systematic exposition - lecture. Case studies. Examples	4 Hours
3. Average molecular masses of polymers. Macromolecular size and polydispersity. Average molecular masses. Distribution of molecular masses. Distribution functions of molecular masses.	Systematic exposition - lecture. Case studies. Examples	2 Hours
4. Synthesis of macromolecules. Theoretical principles of polymer production processes. Polymerization. The fundamental characteristics of radical chain polymerization. The reaction mechanism. Reaction kinetics.	Systematic exposition - lecture. Case studies. Examples	2 Hours
5.Configurational structure of polymers. The regularity of the structure of macromolecular chains. Geometric stereoisomerism. Optical stereoisomerism. Methods of studying the stereoregularity of polymers. Determining the structure of polymers. Spectroscopic methods (Raman).	Systematic exposition - lecture. Case studies. Examples	2 Hours
6. Viscometry of diluted macromolecular solutions. Polymers in solution. Viscometric procedures and methods. Physical-structural peculiarities revealed in the viscometry of dilute solutions of polymers.	Systematic exposition - lecture. Case studies. Examples	2 Hours

References:

1. S. M. R., S. Siengchin, M. Jawaid, ”Handbook of Bioplastics and Biodegradable Polymers: Properties, Processing and Applications”, Wiley–VCH, 2022
2. S. Kabasci, ”Bio-Based Plastics: Materials and Applications”, Wiley, 2020
3. Inamudin, S. Thomas, R.K. Mishra, A.M. Asiri, (Editors), ”Sustainable Polymer Composites and Nanocomposites:, Springer 2021

7.3 Practicals	**Teaching techniques**	**Observations**
Polymer structure identification: FT-IR spectroscopy, Raman spectroscopy, SEM.	Guided practical work	2 Hours
Phase transitions: thermo differential analysis, DSC, TG	Guided practical work	2 Hours
UV photopolymerization. UV influence on the properties of the obtained composite.	Guided practical work	2 Hours
The viscosity of polymer solutions. Determination of viscosity coefficient.	Guided practical work	2 Hours
Characterization of dental composite resins (biodegradable). Determination of ”degree of conversion”.	Guided practical work	2 Hours
Determination of the concentration of some polymer solutions with the help of the refractometer.	Guided practical work	2 Hours
Determination of the density of some polymer solutions with the precision pycnometer. Chemical degradation.	Guided practical work	2 Hours

References:

1. M. S. Chauhan, ”Laboratory Manual for Green Chemistry: Principles and Applications in Polymer Science”, Narosa Publishing, 2021
2. D. Campbell, ”Polymer Characterization: Physical Techniques”, CRC Press, 2020

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Clarity, coherence, and conciseness of the presentation; - Ability to provide relevant examples; - Ability to apply acquired knowledge to solve practical problems.	Oral examination	70%
Practical	Application of specific solution methods for the given problem	Continuos evaluation	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Lector. Dr. Eduard Gâtin	Lector. Dr. Eduard Gâtin

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.104.2 Pollution with plastic materials and waste management

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Pollution with plastic materials and waste management
2.2. Teacher	Lector. Dr. Eduard Gâtin
2.3. Tutorials/Practicals instructor(s)	Lector. Dr. Eduard Gâtin

2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	2	3.2. Lectures	1	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	28	3.5. Lectures	14	3.6. Tutorials/Practicals/Projects	0/14/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	49
Research in library, study of electronic resources, field research	24
Preparation for practicals/tutorials/projects/reports/homework	24
Tutorat	0
Other activities	0
3.7. Total hours of individual study	97
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R3. The student/graduate knows the theoretical and practical concepts regarding the properties and functionalities of advanced materials (polymer materials, nanomaterials, hybrid composites or porous materials) for their application in environmental monitoring and remediation processes. R6. The student/graduate understands the mechanisms of pollutant transport and transformation, the sources and impact of plastic and radioactive materials, the functioning of green energy systems, as well as the methodological framework for environmental and energy audits.
Skills	R3. The student/graduate can identify and analyze the characteristics of materials in relation to environmental applications, use characterization techniques and integrate these materials into sustainable technological solutions, conducting scientific research in the field of ecological materials with a focus on sustainability and reduced environmental impact. R6. The student/graduate can implement methods for analyzing the impact of pollutants and the life cycle of materials, understand the transport and transformation processes of substances in the environment, and systematically use audit techniques and strategies for sustainable resource and waste management.

Responsibility and autonomy	R3. The student/graduate has the ability to plan and implement complex projects in the field of atmospheric and climatic phenomena, as well as sustainable materials designed to reduce environmental impact, effectively disseminating the results in the scientific community. R6. The student/graduate has the ability to choose optimal solutions that offer the greatest benefit in a given context, developing and implementing strategies to reduce environmental impact, reporting audit results and substantiating decisions regarding energy and ecological sustainability.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. Introduction to Plastic Pollution. Understand global plastic production, usage trends, and the concept of plastic as a persistent pollutant.	Systematic exposition - lecture. Examples	2 Hours
2. Types of Plastics and Their Environmental Behavior. Classify plastics (PE, PET, PVC, etc.) and discuss their physical/chemical properties and degradation in various environments.	Systematic exposition - lecture. Examples	2 Hours
3. Sources and Pathways of Plastic Pollution. Identify primary vs. secondary microplastics, land-based vs. marine sources, and atmospheric pathways.	Systematic exposition - lecture. Examples	2 Hours
4. Environmental and Health Impacts of Plastic Waste. Analyze how plastics affect terrestrial and aquatic ecosystems, and human health via ingestion, inhalation, and contamination.	Systematic exposition - lecture. Examples	2 Hours
5. Microplastics and Nanoplastics. Define, classify, and explore the formation, detection methods, and risks associated with micro- and nanoplastics.	Systematic exposition - lecture. Examples	2 Hours
6. Plastic Recycling Technologies. Mechanical, chemical, and biological recycling; discuss pyrolysis, enzymatic degradation, and sorting challenges.	Systematic exposition - lecture. Examples	2 Hours
7. Waste Management Systems. Collection, sorting, landfill management, incineration, and informal waste sectors.	Systematic exposition - lecture. Examples	2 Hours

References:

1. A. Andrady, ”Plastics and the Environment”, Wiley, 2003
2. S.J. Morath, ”Our Plastic Problem and How to Solve It”, Cambridge University Press, 2021
3. T. M. Letcher, ”Plastic Waste and Recycling”, Elsevier, 2020

7.3 Practicals	**Teaching techniques**	**Observations**
Identification and Classification of Plastic Waste: Burn test and density test, FT-IR spectroscopy, Raman spectroscopy, SEM.	Guided practical work	4 Hours
Microplastic Extraction from Water Samples. Filtration of water samples. Visual inspection under microscope.	Guided practical work	4 Hours
Soil Sampling and Microplastic Separation. Soil drying and sieving. Saline solution (NaCl or $ZnCl_2$) density floatation. Microscopy of recovered particles	Guided practical work	4 Hours
Plastic Waste Audit and Mitigation Plan. Audit plastic waste from class/lab. Propose changes to reduce, reuse, or substitute	Guided practical work	2 Hours

References:

1. F. Regan, B. Gruber, ”Environmental Analytical Chemistry: Monitoring and Management of Contaminants”, Wiley, 2023
2. J. Lead, ”Environmental Sampling and Analysis for Plastics and Microplastics”, Elsevier, 2024
3. H. Md. Anawar , ”Sustainable Waste Management: Policies, Practices, and Technologies”, Springer 2022

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Clarity, coherence, and conciseness of the presentation; - Ability to provide relevant examples; - Ability to apply acquired knowledge to solve practical problems. - Application of specific solution methods for the given problem	Oral examination	70%
Practical	Application of specific solution methods for the given problem	continuos evaluation	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions.		

Date,
13.07.2025

Teacher's
name and signature,
Lector. Dr. Eduard Gâtin

Practicals/Tutorials/Project instructor(s),
name and signature
Lector. Dr. Eduard Gâtin

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.105.1 Polymer degradation methods

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Polymer degradation methods						
2.2. Teacher	Prof. Dr. Valentin Barna						
2.3. Tutorials/Practicals instructor(s)	Prof. Dr. Valentin Barna						
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					60
Research in library, study of electronic resources, field research					30
Preparation for practicals/tutorials/projects/reports/homework					29
Tutorat					0
Other activities					0
3.7. Total hours of individual study					119
3.8. Total hours per semester					175
3.9. ECTS					7

4. Prerequisites (if necessary)

4.1. curriculum	Thermodynamics and statistical physics, Optics, Atom and molecule physics.
4.2. competences	Good level of understanding of the knowledge of thermodynamics and statistical physics. Notions of spectroscopy and atomic and nuclear physics. The ability to use correctly the laboratory equipment

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment (Computer, video projector, internet connection); Course notes; Recommended bibliography
5.2. for tutorials/practicals	Laboratory with the equipment necessary to carry out practical work: computer, video projector, software packages, internet connection. Seminar room.

6. Learning outcomes

Knowledge	R3. The student/graduate knows the theoretical and practical concepts regarding the properties and functionalities of advanced materials (polymer materials, nanomaterials, hybrid composites or porous materials) for their application in environmental monitoring and remediation processes. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis.

Skills	R3. The student/graduate can identify and analyze the characteristics of materials in relation to environmental applications, use characterization techniques and integrate these materials into sustainable technological solutions, conducting scientific research in the field of ecological materials with a focus on sustainability and reduced environmental impact. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests.
Responsibility and autonomy	R3. The student/graduate has the ability to plan and implement complex projects in the field of atmospheric and climatic phenomena, as well as sustainable materials designed to reduce environmental impact, effectively disseminating the results in the scientific community. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introduction to Polymer Degradation. Definitions, degradation vs. aging, overview of mechanisms.	Systematic exposition - lecture. Examples.	2 Hours
Chemical transformations of polymers. Macromolecular reactions. Reactions of functional groups of polymers. Degradation of polymers. Durability of polymer materials.	Systematic exposition - lecture. Examples.	4 Hours
Methods of chemical degradation of polymers. Theoretical principles of polymer degradation processes. Reaction mechanism and kinetics. Protolytic degradation. Oxidative degradation.	Systematic exposition - lecture. Examples.	4 Hours
Methods of protecting polymers against degradation under the action of chemical factors. Methods of protecting polymers against degradation under the action of chemical factors.	Systematic exposition - lecture. Examples.	2 Hours
Degradation of polymers under the action of physical factors. Degradation under the influence of light. Degradation under the action of high-energy radiation. Radio-oxidation. Thermal degradation of polymers. Aging of polymers.	Systematic exposition - lecture. Examples.	4 Hours
Methods of protecting polymers against degradation under the action of physical factors.	Systematic exposition - lecture. Examples.	2 Hours
Degradation of polymers under the action of biological factors. Biochemistry of polymer degradation processes. Biodegradable polymers. Uses of biodegradable polymers. Biomaterials.	Systematic exposition - lecture. Examples.	4 Hours
Methods of investigation and diagnosis of polymer degradation. Mechanical methods. Mechanical testing of polymers. The hardness of polymers.	Systematic exposition - lecture. Examples.	4 Hours
Spectroscopic methods of investigation. Laboratory aging of polymer samples.	Systematic exposition - lecture. Examples.	2 Hours

References:

1. S. H. Hamid, ”Handbook of Polymer Degradation”, 2-nd Edition, CRC Press, 2020
2. M. Kutz, ”Environmental Degradation of Materials”, Wiley, 2021
3. W. Bremser, ”Characterization of Polymer Degradation”, Wiley, 2022
4. B. Baskar, A. Pandey, ”Biodegradable Polymers in the Circular Plastics Economy”, CRC Press, 2023

7.3 Practicals	**Teaching techniques**	**Observations**
FTIR Characterization of Degraded Polymers	Guided practical work	4 Hours
Phase transitions: thermodifferential analysis, DSC, TG	Guided practical work	4 Hours
Thermomechanical analysis	Guided practical work	4 Hours
Oxidative Degradation and Antioxidant Effectiveness	Guided practical work	2 Hours

UV Aging and Photodegradation	Guided practical work	6 Hours
Hydrolytic Degradation of Polyesters	Guided practical work	2 Hours
Biodegradation in Soil or Compost (Long-Term Setup)	Guided practical work	6 Hours

References:

1. F. Regan, B. Gruber, ”Environmental Analytical Chemistry: Monitoring and Management of Contaminants”, Wiley, 2023
2. J. D. Menczel, R. B. Prime, ”Thermal Analysis of Polymers: Fundamentals and Applications”, 2-nd Edition, Wiley, 2020
3. T. R. Crompton, ”FTIR Spectroscopy in Polymer Analysis”, Smithers Rapra, 2021

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Clarity, coherence, and conciseness of the presentation; - Ability to provide relevant examples; - Ability to apply acquired knowledge to solve practical problems. - Application of specific solution methods for the given problem	1. Mid-term examination. Theoretical knowledge checking-oral exam. 35% 2. Final examination. Oral theoretical knowledge exam. 35%	70%
Practical	Application of specific solution methods for the given problem	Continuous evaluation	30%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all lab sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Prof. Dr. Valentin Barna	Prof. Dr. Valentin Barna

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.105.2 Renewable energy sources

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Renewable energy sources
2.2. Teacher	Conf.Dr. Anca Dumitru
2.3. Tutorials/Practicals instructor(s)	Conf.Dr Anca Dumitru

2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	60
Research in library, study of electronic resources, field research	30
Preparation for practicals/tutorials/projects/reports/homework	29
Tutorat	0
Other activities	0
3.7. Total hours of individual study	119
3.8. Total hours per semester	175
3.9. ECTS	7

4. Prerequisites (if necessary)

4.1. curriculum	Basic knowledge of Physics, Mathematics and Chemistry
4.2. competences	use of software packages for data analysis and processing

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia devices
5.2. for tutorials/practicals	Set of practical work illustrating the topics covered in the course; Consumables; Computers and software for data analysis

6. Learning outcomes

Knowledge	R2. The student/graduate knows the natural and anthropogenic factors that determine climate variability and change, methods for monitoring and modeling environmental parameters, as well as their effects on the environment and society. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society.

Skills	R2. The student/graduate can critically analyze climate data to interpret the behavior of environmental systems, evaluating and interpreting parameters based on experimental and modeled data, estimating possible evolutions of the climate system. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner.
Responsibility and autonomy	R2. The student/graduate has the ability to plan and implement physical investigations on the environment, to interpret and use climate information in the decision-making process and to contribute to the development of solutions for adapting and mitigating the impact of climate change, effectively communicating the results within the scientific community and collaborating interdisciplinary. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Introductive information. Classification of energy sources. Non-renewable energy sources. Renewable energy sources. Climate change and energy efficiency objectives. The energy policies at the European Union and at the national level	Lecture. Case study presentations. Discussions	6 Hours
Bioenergy or Biomass. Methods of energy conversion from biomass. Biomass fuels. Energy from waste recycling. The advantages of biomass energy	Lecture. Case study presentations. Discussions	2 Hours
Wind energy. Characteristics of wind energy systems. Wind power plants. The advantages and disadvantages of wind energy	Lecture. Case study presentations. Discussions	2 Hours
Hydroenergy. Tide and wave power energy.	Lecture. Case study presentations. Discussions	2 Hours
Geothermal energy. Geothermal systems. The principle of operation. Conversion of geothermal energy into thermal energy. The advantages of using geothermal systems	Lecture. Case study presentations. Discussions	2 Hours
Solar energy. The principle of operation of solar energy systems. Solar - thermal conversion. Solar-electric conversion. The advantages of using solar energy.	Lecture. Case study presentations. Discussions	4 Hours
Hydrogen economy. Production, storage and transport of hydrogen	Lecture. Case study presentations. Discussions	2 Hours
Fuel cells: fuel cells with proton exchange membranes, alkaline fuel cells, solid oxide fuel cells.	Lecture. Case study presentations. Discussions	4 Hours
Microbial fuel cells.	Lecture. Case study presentations. Discussions	2 Hours
Future directions of renewable energy. Energy efficiency. Green energy.	Lecture. Case study presentations. Discussions	2 Hours

References:

7.3 Practicals	Teaching techniques	Observations
Presentation of the practical work. Training for laboratory work and safety	lecture	2 Hours
Solar Energy Experiments	guided practical activity	4 Hours
Wind Energy Experiments	guided practical activity	4 Hours
Start-up and operation of microbial fuel cells	guided practical activity	8 Hours
Energy from Hydrogen Experiments. Fue cells. Electrolizers	guided practical activity	6 Hours
Combination of solar energy with electrolysis	guided practical activity	4 Hours

References:
Mark Z. Jacobson, No Miracles Needed, Cambridge University Press, 2023, https://doi.org/10.1017/9781009249553; M. Kanoglu, Y. A. Cengel, J. M. Cimbala, Fundamentals and Applications of Renewable Energy, ISBN: 9781260455304; Publication Date and Copyright: 2023, McGraw Hill; Energy Institute - Statistical Review of World Energy; Renewable energy science kit , www.horizoneducational.com;Anca Dumitru and Keith Scott, Microbial Electrochemical and Fuel Cells. Fundamentals and Applications, Edition: 1, Chapter: Anode Materials for microbial fuel cells, Publisher: Woodhead Publishing, Editors: Keith Scott, Eileen Hao Yu, 2016, Pages 117-152 https://doi.org/10.1016/B978-1-78242-375-1.00004-6

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and terminology used in renewable energy source area - ability to indicate/analyze specific examples	oral examination	70%
Practical	- ability to use specific experimental methods/apparatus - ability to analyse and interpret the characterization data - ability to present and discuss the results	Examination of Lab reports	30%
Minimal requirements for passing the exam	correct use of knowledge and terminology used in renewable energy source area		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf.Dr. Anca Dumitru	Conf.Dr Anca Dumitru

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.109.1 Radionuclides, environmental radioactivity and radioactive waste management

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Radionuclides, environmental radioactivity and radioactive waste management						
2.2. Teacher	Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache						
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	exam	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					72
Research in library, study of electronic resources, field research					36
Preparation for practicals/tutorials/projects/reports/homework					36
Tutorat					0
Other activities					0
3.7. Total hours of individual study					144
3.8. Total hours per semester					200
3.9. ECTS					8

4. Prerequisites (if necessary)

4.1. curriculum	Nuclear Physics, Mathematics, Equations of mathematical physics, Quantum physics, Statistical physics. Numerical methods. Programming languages.
4.2. competences	Programming languages for science. Software for processing of nuclear data and graphics.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom equipped with multimedia devices
5.2. for tutorials/practicals	Set of practical work illustrating the topics covered in the course.

6. Learning outcomes

Knowledge	R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R6. The student/graduate understands the mechanisms of pollutant transport and transformation, the sources and impact of plastic and radioactive materials, the functioning of green energy systems, as well as the methodological framework for environmental and energy audits. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation.

Skills	R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R6. The student/graduate can implement methods for analyzing the impact of pollutants and the life cycle of materials, understand the transport and transformation processes of substances in the environment, and systematically use audit techniques and strategies for sustainable resource and waste management. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials.
Responsibility and autonomy	R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R6. The student/graduate has the ability to choose optimal solutions that offer the greatest benefit in a given context, developing and implementing strategies to reduce environmental impact, reporting audit results and substantiating decisions regarding energy and ecological sustainability. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Cosmic rays. Primary and secondary cosmic rays. Cosmogenic radionuclides. Production mechanisms and rates, example (C-14, H-3, Be-7 and other radionuclides). Applications	Systematic exposure - lecture. Examples.	4 Hours
Cosmogenic nuclides in situ, examples. Production mechanisms and rates (with or without erosion). Applications	Systematic exposure - lecture. Examples.	2 Hours
Natural decay series. Secular equilibrium, Applications.	Systematic exposure - lecture. Examples.	2 Hours
Natural radioactivity. Uranium. Thorium. Ra-266, Radon, Toron and their descendants. Distribution of radon and its descendants in the atmosphere. High natural background radiation areas. Contributions to the natural radioactive background	Systematic exposure - lecture. Examples.	3 Hours
Dating methods using radioactive isotopes (K-Ar, Rb-Sr, U-Pb methods, Pb-210 activity measurements in sediments). Applications	Systematic exposure - lecture. Examples.	3 Hours
Sources of exposure to ionising radiation. Radiotoxicity. Biokinetic models for the assay of internal doses due to the incorporation of radionuclides. Dose - response models used to evaluate the risk of exposure to ionising radiation. Applications	Systematic exposure - lecture. Examples.	2 Hours
The assessment of exposure to indoor radon. Potential alfa energy (PAE) and PAE concentration (PAEC). Radon / thoron equilibrium indoors; the equilibrium coefficient. Building materials as sources of radon. Radon attachment to the aerosols. Indoor radon measurements. Doses due to radon and descendants. Standards and regulations related to radon exposure. Applications	Systematic exposure - lecture. Examples.	2 Hours
Radioactive contamination of the environment. Sources of contamination. NORM and TENORM. Radioactive effluents. Methods for establishing the derived limits for radioactive effluents. Applications	Systematic exposure - lecture. Examples.	2 Hours

Nuclear and radiological accidents and incidents. The INIS scale. Models for the atmospheric dispersion of radioactive emissions. Environmental contamination subsequent to the accidents and methods for environmental monitoring. Rules for the response to nuclear / radiological accidents. Examples: the Chernobil and Fukushima accidents. The radiological accident from Gôiania. applications	Systematic exposure - lecture. Examples.	4 Hours
Managament of radioactive waste. Categorising and characterisation of radioactive waste. Processing and storage of radioactive waste. Orphan sources. Examples.	Systematic exposure - lecture. Examples.	4 Hours

References:

1. G.Vladuca ”Elemente de fizica nucleara”, partea I, Ed.Univ.Buc., 1988.
2. G.Vladuca ”Elemente de fizica nucleara”, partea a II-a, Ed.Univ.Buc., 1990.
3. O. Sima, Note de curs Radioactivitatea mediului.
4. A.Tudora, E.Sartori ”Biblioteci de date nucleare si coduri de calcul din domeniul nuclear ≫, Ed.Univ. Buc.1999.
5. V. Valcovic, Radioactivity in the environment, Elsevier, 2000.
6. M. Eisenbud, T. Gessel, Environmental radioactivity, Academic Press, 1997
7. M. L'Anunziata, Handbook of Radioactivty Analysis, Academic Press 2012
8. Report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), editiile din 1988, 1993, 1996, 2000, 2008, 2010 etc.; http://www.unscear.org/unscear/en/publications.html
9. V.Cuculeanu ”Fizica si calculul reactorilor nucleari cu neutroni rapizi”, Ed.Teh.,Buc., 1982
10. Reveica Ion-Mihai, Radioactivitatea si circuitul izotopilor radioactivi in mediu, Ed. Univ.Buc., 1998.
11. O.Duliu, Aplicatiile radioatiilor nucleare, Ed.Univ.Buc., 1993.
12. C. Cosma, T. Jurcut, Radonul si mediul inconjurator, Editura Dacia, 1996

7.3 Practicals	Teaching techniques	Observations
Applications concerning the radioactive series and the secular equilibrium.		4 Hours
Gamma spectrometry with NaI(Tl) detectors. Gamma spectrometry analysis of a pitchblende sample		2 Hours
Study of self-absorption effects in thick radioactive samples		2 Hours
Determination of the density variation of samples by the transmission of beta radiation		2 Hours
Measurement of the half-life of 40K using a KCl sample		2 Hours
Data analysis to obtain isochronous curves in dating applications		2 Hours
The calculation of derived activity concentrations for water and air effluents.		2 Hours
Evaluation of radioactive contamination of the environment after a single emission incident using the Gaussian dispersion model.		4 Hours
Methods for finding and identifying an orphan source		2 Hours
Practical exercise of intervention in the case of a nuclear accident		4 Hours
Measurement of area contamination using low level alpha beta counting.		2 Hours

References:

1. G.Vladuca ”Elemente de fizica nucleara”, partea I, Ed.Univ.Buc., 1988.
2. G.Vladuca ”Elemente de fizica nucleara”, partea a II-a, Ed.Univ.Buc., 1990.
3. A.Tudora, E.Sartori ”Biblioteci de date nucleare si coduri de calcul din domeniul nuclear≫, Ed.Univ. Buc.1999.
4. O. Sima, Note de curs Radioactivitatea mediului.
5. Reveica Ion-Mihai, Radioactivitatea si circuitul izotopilor radioactivi in mediu, Ed. Univ.Buc., 1998.
6. O.Duliu, Aplicatiile radioatiilor nucleare, Ed.Univ.Buc., 1993.

IAEA (www.iaea.org), IAEA Nuclear Data Section (www-nds.iaea.org): the nuclear data libraries RIPL and EXFOR.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Given the special importance of the discipline for applications in the field of nuclear physics (multiple applications in all fields, industry, medicine, agriculture, energy, etc.) in order to prepare the contents and choose the teaching/learning methods, the teachers of the discipline consulted the content of similar couses taught at universities abroad (Université de Bordeuaux, Université Paris-Sud, Université Catholique Louvain-la-Neuve, etc.). The content of the discipline is in accordance with the employment requirements in research institutes in the field of nuclear physics and nuclear reactors, at nuclear power plants and in higher education field (according to the law).

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of equations/mathematical methods/physical models and theories - ability to indicate and analyze specific examples	Oral examination	70%
Tutorial			30%
Minimal requirements for passing the exam	Minimal requirements for passing the exam Correct understanding of the concepts and phenomena, the ability to work in a team and to obtain accurate numerical results on topics imposed. Requirements for mark 5 (10 points scale) • Finalization of the tasks given during the practical activities. • Correct exposure of the subjects indicated to obtain 5 at the final exam.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache	Conf. dr. Oana Ristea, Lect. dr. Radu Vasilache

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.109.2 Modeling environmental and astrophysical processes

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Modeling environmental and astrophysical processes
2.2. Teacher	Prof. dr. Mihai Dima
2.3. Tutorials/Practicals instructor(s)	CS I dr. Mirel Birlan

2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	72
Research in library, study of electronic resources, field research	36
Preparation for practicals/tutorials/projects/reports/homework	36
Tutorat	0
Other activities	0
3.7. Total hours of individual study	144
3.8. Total hours per semester	200
3.9. ECTS	8

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R2. The student/graduate knows the natural and anthropogenic factors that determine climate variability and change, methods for monitoring and modeling environmental parameters, as well as their effects on the environment and society. R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society.

Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R2. The student/graduate can critically analyze climate data to interpret the behavior of environmental systems, evaluating and interpreting parameters based on experimental and modeled data, estimating possible evolutions of the climate system. R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner.
Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R2. The student/graduate has the ability to plan and implement physical investigations on the environment, to interpret and use climate information in the decision-making process and to contribute to the development of solutions for adapting and mitigating the impact of climate change, effectively communicating the results within the scientific community and collaborating interdisciplinary. R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Fundamentals of numerical forecasting models	Systematic exposition - lecture. Conversation. Examples	4 Hours
Parametrization schemes: cloud microphysics, convection and surface processes	Systematic exposition - lecture. Conversation. Examples	4 Hours
Data assimilation in numerical forecasting models	Systematic exposition - lecture. Conversation. Examples	4 Hours
Uncertainty and ensembles. Probabilistic forecasts	Systematic exposition - lecture. Conversation. Examples	2 Hours
Elements of fundamental astronomy: reference systems, orbital elements, ephemeris	Systematic exposition - lecture. Conversation. Examples	2 Hours

Time scales in astronomy; distance scales in astronomy	Systematic exposition - lecture. Conversation. Examples	2 Hours
Astronomical instruments	Systematic exposition - lecture. Conversation. Examples	4 Hours
Presentation of the solar system	Systematic exposition - lecture. Conversation. Examples	4 Hours
Exoplanets: detection, dynamic analysis	Systematic exposition - lecture. Conversation. Examples	2 Hours

References:
Coiffier, J., FundamentalsCesare of Numerical Weather Prediction, Cambridge University Press, 2012.
Barbieri, C., Bertini, I, Fundamentals of Astronomy, CRS Press. 2020.

7.3 Practicals	**Teaching techniques**	**Observations**
Calculation of finite-difference derivatives on a 1D grid	Guided practical activity	2 Hours
Bilinear interpolation of temperature between two-points networks	Guided practical activity	4 Hours
Comparing a numerical forecast with real observations: calculation of errors	Guided practical activity	4 Hours
Visualization of meteorological data (temperature, wind) from a NetCDF file	Guided practical activity	4 Hours
Presentation of the night sky, night observations	Guided practical activity	2 Hours
Studying the celestial sphere using the Stellarium program	Guided practical activity	4 Hours
Reduction of astronomical images. Obtaining astrometric data of	Guided practical activity	4 Hours
Presentation of astronomical instruments installed at the Astronomical Institute	Guided practical activity	4 Hours

References:
Coiffier, J., FundamentalsCesare of Numerical Weather Prediction, Cambridge University Press, 2012.
Barbieri, C., Bertini, I, Fundamentals of Astronomy, CRS Press. 2020.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms competences and abilities which are important for an undergraduate student in the field of modern Physics, corresponding to national and international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union. The contents are in line with the requirements/expectations of the main employers of the graduates.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - correct use of knowledge and terminology used in lectures - ability to indicate/analyse specific examples - correct use of equations/mathematical methods/physical models and theories	Written examination	70%
Practical	- ability to analyse and interpret the data - ability to present and discuss the results		30%

Minimal requirements for passing the exam	Completion of 80% laboratory and mark 5 at the colloquium

Date,
13.07.2025

Teacher's
name and signature,
Prof. dr. Mihai Dima

Practicals/Tutorials/Project instructor(s),
name and signature
CS I dr. Mirel Birlan

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.110.1 Statistical methods in Earth and Atmosphere Physics

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Statistical methods in Earth and Atmosphere Physics						
2.2. Teacher	Conf. dr. Cristian Necula						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Cristian Necula						
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					72
Research in library, study of electronic resources, field research					36
Preparation for practicals/tutorials/projects/reports/homework					36
Tutorat					0
Other activities					0
3.7. Total hours of individual study					144
3.8. Total hours per semester					200
3.9. ECTS					8

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.
Skills	R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.

Responsibility and autonomy	R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
1. The aim of the course. R programming platform as medium for statistical calculus and graphics. Install R, setup R for the present lectures, working with R, installing additional packages.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
2. Statistics and probabilities. Discrete and continuous praobability distributions. Mean, standard deviation, confidence level for the mean, median. Quartile, percentile. Student-t test and F test.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
3. Correlation. Correlation coefficient, determination coefficient, signification test and confidence levels for correlation coefficient, influence of extreme values on the correlation coefficient.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	6 Hours
4. Linear regression. Parameters of straight line model. Confidence levels for slope and intercept. Predictions for mean, a single future observation etc. Multiple linear regression. Regressors identification. Non-linear regression.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	6 Hours
5. Cluster analysis. Data normalization. Hierarchical clusters. K-mean clusters. Determination of optimal numar of clusters by "silhouette" plot.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
6. techniques for dimensions reduction. Principal Component Analysis. Redundant data. Principal components and loadings.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours

References:

7.3 Practicals	Teaching techniques	Observations
1. Generation of data using R. Working with R, plot and functions. Applications on synthetic data.	Supervised practical activity	4 Hours
2. Examples of probability distributions. Determination of mean, standard deviation, median, quartile and percentile, confidence intervals, etc. for real data. Student-t test and F test for real data.	Supervised practical activity	4 Hours
3. Determination of correlation coefficient for real data. Significance test and confidence interval for correlation coefficient. Influences of extrema on correlation using R.	Supervised practical activity	4 Hours
4. Linear regression with real data using R. Calculus for fitting parameters and their confidence intervals using R. Multiple linear regression and non-linear regression în R. Examples for synthetic and real data.	Supervised practical activity	6 Hours
5. Application of cluster analysis on real and synthetic data.	Supervised practical activity	6 Hours
6. Application of Principal component analysis on real and synthetic data.	Supervised practical activity	4 Hours

References:

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	coherence and clarity of exposition appropriate use of environmental magnetism methods and concepts - ability to apply to specific examples		50%
Practical	Application of environmental magnetism methods on a given particular data - results interpretation		50%
Minimal requirements for passing the exam	Achieving a minimum grade of 5 in exam. Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Cristian Necula	Conf. dr. Cristian Necula

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.110.2 Time series analysis

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Time series analysis						
2.2. Teacher	Conf. dr. Cristian Necula						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Cristian Necula						
2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					72
Research in library, study of electronic resources, field research					36
Preparation for practicals/tutorials/projects/reports/homework					36
Tutorat					0
Other activities					0
3.7. Total hours of individual study					144
3.8. Total hours per semester					200
3.9. ECTS					8

4. Prerequisites (if necessary)

4.1. curriculum	Electricity and magnetism, solid state physics
4.2. competences	Usage of specific software packages for data analysis and processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom supplied with a projector, internet acces
5.2. for tutorials/practicals	Laboratory equipped with specific devices related to environmental magnetism investigations.

6. Learning outcomes

Knowledge	R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R8. The student/graduate knows the computer tools and specialized programs used in data analysis and computational simulation. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.

Skills	R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R8. The student/graduate can use advanced modeling and simulation software to solve specific problems in environmental physics and the field of ecological materials. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.
Responsibility and autonomy	R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R8. The student/graduate demonstrates autonomy in the exploitation and development of software solutions, assuming responsibility for compliance with licensing models, code quality standards, and collaborative practices specific to software solution development and operation communities. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
1. Representation of a signal in frequency domain. Continuous Fourier Transform. Discrete Fourier Transform. Amplitude, phase, freqeuncy (period), for a signal. Trend and noise. Red noise and white noise.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
2. Trend and red noise effects in frequency domain. Methods for removing trend and noise. Frequency domain filtering of a signal. Time series analysis for irregularly samples time series. Lomb-Scargle Periodogram and CLEAN algorithm.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
3. Bivariate time series analysis. Frequency leakage, spectral windows. Cross-spectrum, coherency, phase difference between two signals.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
4. Non-stationary time series. Windowed Fourier Transform (Short Time Fourier Transform). Continuous and discrete Wavelet transform. Cross-spectrum, coherency, phase difference using continuous wavelet transform. Wavelet analysis for irregularly sampled time series.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
5. Maximal Overlap Discrete Wavelet Transform. Multiresolution analysis. Coherency and phase difference based on multiresolution analysis.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
6. Maximal Overlap Discrete Wavelet Packet Transform. Hilbert spectrum. Filtering using wavelet functions. Coherency and phase difference based on MODWPT.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
7. Multiple and partial coherency and phase difference using wavelets.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours

References:
1. Robert H. Shumway, David S. Stoffer, 2011, Time Series Analysis and Its Applications, With R Examples, Third edition, Springer. 2. Olafsdottir, K. B., Schulz, M. and Mudelsee, M. (2016): REDFIT-X: Cross-spectral analysis of unevenly spaced paleoclimate time series. Computers and Geosciences, 91, 11-18 3. Donald Percival, Andrew Walden, 2000, Wavelet Methods for Time Series Analysis, Cambridge University Press. 4. Stephane Malat, 2005, A wavelet tour of signal processing, Academic Press. 5. D. Heslop, M.J. Dekkers, 2002, Spectral analysis of unevenly spaced climatic time series using CLEAN: signal recovery and derivation of significance levels using a Monte Carlo simulation, Physics of the Earth and Planetary Interiors 130 (2002) 103–116 6. Foster Grant, 1996, Wavelets for period analysis of unevenly sampled time series, The astronomical journal, vol 112, no, 4. 7. BRANDON WHITCHER and PETER F. CRAIGMILE, MULTIVARIATE SPECTRAL ANALYSIS USING HILBERT WAVELET PAIRS, Int. J. Wavelets Multiresolut Inf. Process. 02, 567 (2004) 8. Brandon Whitcher, Peter F. Craigmile, Peter Brown, 2005, Time-varying spectral analysis in neurophysiological time series using Hilbert wavelet pairs, Signal Processing, Volume 85, Issue 11, November 2005, Pages 2065–2081 9. S. OLHEDE AND A. T. WALDEN, 2005, A generalized demodulation approach to time-frequency projections for multicomponent signals, Proc. R. Soc. A (2005) 461, 2159–2179.

7.3 Practicals	Teaching techniques	Observations
1. Generation of periodic signals with various amplitudes, frequencies and phases using Python, Matlab and R. Signal representation în frequency domain using Fourier transform. Periodogram determination. Processing of irregularly sampled natural time series using REDFIT-X.	Supervised practical activity	2 Hours
2. Removing trend. Estimation tehnique of the trend. Remiving noise. White noise and red noise. Welch method. Filtering în frequency domain. Application on synthetic and natural (real) signals.	Supervised practical activity	4 Hours
3. Bivariate signal analysis. Determination of cross-spectrum, coherency and phase diferences on synthetic and natural signals. Processing of the irregularly sampled real signals. Results interpretation. Confidence levels.	Supervised practical activity	4 Hours
4. Stationary and non-stationary signals. Short time Fourier transform (windowed Fourier transform, Evolutionary spectrum) – spectrum. Applications on synthetic and real signals.	Supervised practical activity	4 Hours
5. Continuous wavelet spectrum. Estimation of cross-spectrum, coherency and phase diferences through continuous wavelet transform on natural and synthetic signals. Continuous wavelet spectrum for irregularly sampled time series: Weighted Wavelet Transform.	Supervised practical activity	4 Hours
6. Multiresolution analysis by Maximal Overlap Discrete Wavelet Transform. Spectrum interpretation. Coherency and phase difference. Aplications on natural signals. Results interpretation.	Supervised practical activity	4 Hours
7. Hilbert spectrum using Maximal Overlap Discrete Wavelet Packet Transform (MODWPT). Coherency and phase difference through MODWPT. Filtering by MODWPT on natural signals. Multiple and partial coherency and phase difference using wavelets.	Supervised practical activity	6 Hours

References:
1. Robert H. Shumway, David S. Stoffer, 2011, Time Series Analysis and Its Applications, With R Examples, Third edition, Springer.
2. Olafsdottir, K. B., Schulz, M. and Mudelsee, M. (2016): REDFIT-X: Cross-spectral analysis of unevenly spaced paleoclimate time series. Computers and Geosciences, 91, 11-18
3. Donald Percival, Andrew Walden, 2000, Wavelet Methods for Time Series Analysis, Cambridge University Press.
4. Stephane Malat, 2005, A wavelet tour of signal processing, Academic Press.
5. D. Heslop, M.J. Dekkers, 2002, Spectral analysis of unevenly spaced climatic time series using CLEAN: signal recovery and derivation of significance levels using a Monte Carlo simulation, Physics of the Earth and Planetary Interiors 130 (2002) 103–116
6. Foster Grant, 1996, Wavelets for period analysis of unevenly sampled time series, The astronomical journal, vol 112, no, 4.
7. BRANDON WHITCHER and PETER F. CRAIGMILE, MULTIVARIATE SPECTRAL ANALYSIS USING HILBERT WAVELET PAIRS, Int. J. Wavelets Multiresolut Inf. Process. 02, 567 (2004)
8. Brandon Whitcher, Peter F. Craigmile, Peter Brown, 2005, Time-varying spectral analysis in neurophysiological time series using Hilbert wavelet pairs, Signal Processing, Volume 85, Issue 11, November 2005, Pages 2065–2081
9. S. OLHEDE AND A. T. WALDEN, 2005, A generalized demodulation approach to time-frequency projections for multicomponent signals, Proc. R. Soc. A (2005) 461, 2159–2179.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops theoretical and practical competences and abilities which are important for a Master student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	coherence and clarity of exposition appropriate use of environmental magnetism methods and concepts - ability to apply to specific examples		50%
Practical	Application of environmental magnetism methods on a given particular data - results interpretation		50%
Minimal requirements for passing the exam	Achieving a minimum grade of 5 in exam. Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Cristian Necula	Conf. dr. Cristian Necula

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.204.1 Environmental magnetism / Magnetism cu aplicaţii în fizica mediului

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Environmental magnetism / Magnetism cu aplicaţii în fizica mediului
2.2. Teacher	Conf. dr. Cristian Necula
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Cristian Necula

2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	42	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/14/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	42
Research in library, study of electronic resources, field research	21
Preparation for practicals/tutorials/projects/reports/homework	20
Tutorat	0
Other activities	0
3.7. Total hours of individual study	83
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	Electricity and magnetism, solid state physics
4.2. competences	Usage of specific software packages for data analysis and processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom supplied with a projector, iinternet acces
5.2. for tutorials/practicals	Laboratory equipped with specific devices related to environmental magnetism investigations such as: Princeton Measurements VSM (Vibrating Sample Magnetometer) model 3900 Princeton Measurements AGM 2900 (Alternative Gradient Magnetometer) Magnon International AF demagnetizer with ARM coil. LDA-3A, AGICO with authomatic AF demagnetizer 9T Pulse magnetizer Magnetic Measurements. Kappabridge MFK1-FA AGICO with three frequencies with high temperature furnace and Low Temperature Cryostat Apparatus to monitor the variation of magnetic susceptibility with temperatures between (-190-700C) Magnetic susceptibility meter with multiple frrequencies (14 frequencies) SM100/105 (ZH Instruments) . Software packages (open source or licensed) for FORC processing, magnetic susceptibility variation with temperature, unmixing the IRM curves.

6. Learning outcomes

Knowledge	R5. The student/graduate knows the physical processes that govern the internal structure of the Earth, the propagation of seismic waves, the analysis of gravitational and geomagnetic fields and their interaction with the environment. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis. R12. The student/graduate uses fundamental and specialized notions to explain and interpret various concepts, situations, processes and projects.
Skills	R5. The student/graduate can analyze seismic, magnetic and gravimetric data, using geophysical methods and theoretical models to characterize the structure and internal evolution of the planet. The student/graduate can apply scientific methods and critically interpret experimental data obtained in the laboratory. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests. R12. The student/graduate applies fundamental and specialized knowledge and concepts to explain, present, identify and interpret processes in environmental physics and ecological materials, in concrete situations or within projects and programs specific to the field.
Responsibility and autonomy	R5. The student/graduate has the ability to plan and implement complex projects that integrate geophysical results in applied contexts, such as natural hazards or environmental monitoring, effectively communicating results within research teams and to decision-makers. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions. R12. The student/graduate solves specific requirements by identifying regularities, notions and concepts specific to the field, demonstrating analysis and synthesis skills.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Introduction in rock magnetism: diamagnetism, paramagnetism, ferromagnetism.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Magnetic susceptibility. Magnetic hysteresis. Magnetic parameters used in environmental magnetism.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Magnetic parameters used in environmental magnetism.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
The main magnetic minerals responsible for natural magnetism. Origin, transformation, properties.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Measuring the main magnetic parameters involved in environmental magnetism.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	6 Hours

Unmixing methods of magnetic parameters.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
Magnetoclimatology. Magnetism of terrestrial, marine and lake sediments. Milankovich cycles.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
Magnetic survey of environmental pollution. Soil and atmospheric pollution. Magnetic survey of traffic and industrial pollution.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Archaeomagnetism	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Speleomagnetism	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours

References:

1. Evans, M.E., Heller F., 2003, Environmental Magnetism, Academic Press, 317 pp
2. Maher, B., Thompson, R., 1999, Quaternary Climates, Environments and Magnetism, Cambridge University Press, 403pp.
3. Dunlop, D.J. and Ozdemir, O., 1997. Rock Magnetism: Fundamentals and Frontiers, Cambridge University Press, Cambridge.
4. Tauxe, L., with contributions from: Subir K. Banerjee, Robert F. Butler and Rob van der Voo, 2018, Essentials of Paleomagnetism: Fifth Web Edition, https://earthref.org/MagIC/books/Tauxe/Essentials/
5. Necula., C, 2017, Determinarea proprietăţilor magnetice ale rocilor pe baza histerezisului magnetic, Editura Ars Docendi

7.3 Practicals	**Teaching techniques**	**Observations**
Magnetic susceptibility measuring methods. Frequnecy dependent magnetic susceptibility.	Supervised practical activity	2 Hours
Measuring methods for magnetic hysteresis.	Supervised practical activity	2 Hours
Magnetic mineralogy determination through temperature variation of magnetic susceptibility	Supervised practical activity	2 Hours
Magnetic granulometry estimation using FORC (First Order Reversal Curves) and non-linear Preisach diagrams.	Supervised practical activity	2 Hours
Concentration estimation of single domain particles using ARM (Anhisteretic Remanent Magnetization) and IRM (Isothermal Remanent Magnetization) measurements,	Supervised practical activity	2 Hours
Unmixing magnetic parameters.	Supervised practical activity	2 Hours
Estimating the Grain size distribution of superparamagnetic particles using multiple frequencies magnetic susceptibility measurements.	Supervised practical activity	2 Hours

References:
1. Evans, M.E., Heller F., 2003, Environmental Magnetism, Academic Press, 317 pp 2. Maher, B., Thompson, R., 1999, Quaternary Climates, Environments and Magnetism, Cambridge University Press, 403pp. 3. Dunlop, D.J. and Ozdemir, O., 1997. Rock Magnetism: Fundamentals and Frontiers, Cambridge University Press, Cambridge. 4. Tauxe, L., with contributions from: Subir K. Banerjee, Robert F. Butler and Rob van der Voo, 2018, Essentials of Paleomagnetism: Fifth Web Edition, https://earthref.org/MagIC/books/Tauxe/Essentials/ 5. Necula., C, 2017, Determinarea proprietăţilor magnetice ale rocilor pe baza histerezisului magnetic, Editura Ars Docendi

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops theoretical and practical competences and abilities which are important for a Master student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from Romania or the European Union

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - appropriate use of environmental magnetism methods and concepts - ability to apply to specific examples		50%
Practical	- Application of environmental magnetism methods on a given particular data - results interpretation		50%
Minimal requirements for passing the exam	- Achieving a minimum grade of 5 in exam. - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf. dr. Cristian Necula	Conf. dr. Cristian Necula

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026

DO.204.2 Earth's geomagnetic and gravity fields / Câmpurile geomagnetic şi gravitaţional ale Pământului

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Earth's geomagnetic and gravity fields / Câmpurile geomagnetic şi gravitaţional ale Pământului						
2.2. Teacher	Conf. dr. Cristian Necula						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Cristian necula						
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	42	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/14/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					42
Research in library, study of electronic resources, field research					21
Preparation for practicals/tutorials/projects/reports/homework					20
Tutorat					0
Other activities					0
3.7. Total hours of individual study					83
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Electricity and magnetism, solid state physics
4.2. competences	Usage of specific software packages for data analysis and processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom supplied with a projector
5.2. for tutorials/practicals	Software packages (open source or licensed) to analyze gravitational and geomagnetic fields, on-line access to international database in geomagnetism, experiments in geomagnetism and gravitational field.

6. Learning outcomes

Knowledge	R5. The student/graduate knows the physical processes that govern the internal structure of the Earth, the propagation of seismic waves, the analysis of gravitational and geomagnetic fields and their interaction with the environment.
Skills	R5. The student/graduate can analyze seismic, magnetic and gravimetric data, using geophysical methods and theoretical models to characterize the structure and internal evolution of the planet. The student/graduate can apply scientific methods and critically interpret experimental data obtained in the laboratory.
Responsibility and autonomy	R5. The student/graduate has the ability to plan and implement complex projects that integrate geophysical results in applied contexts, such as natural hazards or environmental monitoring, effectively communicating results within research teams and to decision-makers.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
1. Historical introduction. Elements of the geomagnetic field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
2. Models of the geomagnetic field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
3. External geomagnetic field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
4. Main geomagnetic field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
5. Elements of paleomagnetism	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	4 Hours
6. Paleosecular variation	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
7. Reversal of the geomagnetic field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
8. Origin of the geomagnetic field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
9. Gravific field	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
10. Interpretation of gravity anomalies	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
11. The Earth's size and shape	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours

References:

Fowler, C.M.R., 1990.The solid Earth. An introduction to global geophysics. Cambridge University Press,
Jacobs, J.A., 1994. Reversals of the earth's magnetic field. Cambridge University Press
Lowrie, W., 1991. Fundamentals of Geophysics. Cambridge University Press
Merrill, R.T., McElhinny, M.W., McFadden, P.L., 1994. The magnetic field of the Earth. Academic Press.
Panaiotu, C., 2006, Geomagnetism, Editura Ars Docendi, Bucureşti, pp. 85

7.3 Practicals	Teaching techniques	Observations
1. Instruments in geomagnetism	Supervised practical activity	2 Hours
2. Statistical analysis of directional data	Supervised practical activity	2 Hours

3. Analysis of the external geomagnetic field using Intermagnet network	Supervised practical activity	2 Hours
4. Analysis of the main geomagnetic field using Intermagnet network	Supervised practical activity	2 Hours
5. Modeling geomagnetic anomalies	Supervised practical activity	2 Hours
6. Modeling gravity anomalies	Supervised practical activity	4 Hours

References:

owler, C.M.R., 1990.The solid Earth. An introduction to global geophysics. Cambridge University Press,
Jacobs, J.A., 1994. Reversals of the earth's magnetic field. Cambridge University Press
Lowrie, W., 1991. Fundamentals of Geophysics. Cambridge University Press
Merrill, R.T., mcElhinny, M.W., McFadden, P.L., 1994. The magnetic field of the Earth. Academic Press.
Panaiotu, C., 2006, Geomagnetism, Editura Ars Docendi, Bucureşti, pp. 85

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

This course unit forms/develops theoretical and practical competences and abilities which are important for a Master student in the field of modern Physics, corresponding to national and european/international standards. The contents and teaching methods were selected after a thorough analysis of the contents of similar course units in the syllabus of other universities from the European Union.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- coherence and clarity of exposition - appropriate use of methods and concepts - ability to apply to specific examples	Exam (oral)	50%
Practical	- Analysis of geomagnetic and gravity fields - results interpretation	Verification	50%
Minimal requirements for passing the exam	- Achieving a minimum grade of 5 in exam. - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions.		

Date,
13.07.2025

Teacher's
name and signature,
Conf. dr. Cristian Necula

Practicals/Tutorials/Project instructor(s),
name and signature
Conf. dr. Cristian necula

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.205.1 Earth radiation budget / Bugetul radiativ al planetei

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Earth radiation budget / Bugetul radiativ al planetei
2.2. Teacher	Lect. dr. Gabriela Iorga
2.3. Tutorials/Practicals instructor(s)	Lect. dr. Gabriela Iorga

2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	35
Research in library, study of electronic resources, field research	17
Preparation for practicals/tutorials/projects/reports/homework	17
Tutorat	0
Other activities	0
3.7. Total hours of individual study	69
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	Optics, Electricity, Thermodynamics, Notions of mathematics and chemistry
4.2. competences	Knowledge and practical capabilities of using the computer - Use of software packages for data analysis and processing

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment, white/black board and with internet connection, possibility of multiplying didactic materials in advance
5.2. for tutorials/practicals	Laboratory with modern equipment that allows fundamental experiments to be carried out; Computers and acquisition interfaces enabling computer-aided experiments; Access to the equipment for radiation measurements and air sampling (gases, aerosols) and to databases with atmospheric observations; Dedicated calculation programs (licensed or open source) for determining the optical parameters of the aerosol, for determining the radiation fluxes at different levels in the atmosphere, various Excel spreadsheets for determining the radiative forcing of gases and aerosols

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R2. The student/graduate knows the natural and anthropogenic factors that determine climate variability and change, methods for monitoring and modeling environmental parameters, as well as their effects on the environment and society.

Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R2. The student/graduate can critically analyze climate data to interpret the behavior of environmental systems, evaluating and interpreting parameters based on experimental and modeled data, estimating possible evolutions of the climate system.
Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R2. The student/graduate has the ability to plan and implement physical investigations on the environment, to interpret and use climate information in the decision-making process and to contribute to the development of solutions for adapting and mitigating the impact of climate change, effectively communicating the results within the scientific community and collaborating interdisciplinary.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
Basic knowledge about radiation. Radiation laws for the black body: Rayleigh-Jeans, Planck, Stefan-Boltzmann, Wien displacement law. Kirchhoff's law.	Lecture, description, explanation, conversation, debate	2 Hours
The Sun as a source of radiation. The electromagnetic spectrum and radiation emission by the Sun and the Earth.	Lecture, description, explanation, conversation, debate	2 Hours
Radiative transfer in the terrestrial atmosphere. The equation of radiative transport in the atmosphere. Extinction of solar radiation by scattering and absorption. Beer-Bouguer-Lambert law.	Lecture, description, explanation, conversation, debate	4 Hours
The global radiation balance/budget (definition, for the Earth, in the absence of the atmosphere; for the Earth-atmosphere system; the observed balance)	Lecture, description, explanation, conversation, debate	3 Hours
Factors that influence the radiation balance/budget of the Earth. Greenhouse gases. Aerosols. Clouds. The nature of the Earth's surface.	Lecture, description, explanation, conversation, debate	6 Hours
Time scales at which the Earth's radiation balance changes.	Lecture, description, explanation, conversation, debate	1 Hour
Radiative forcing (concept, modeling of GHG and aerosol forcing). The response of the climate system to radiative forcing. Feedbacks in the climate system.	Lecture, description, explanation, conversation, debate	8 Hours
The evolution of knowledge in the field of radiative transfer in the atmosphere.	Lecture, description, explanation, conversation, debate	2 Hours

References:

1. Cotton, W.R., Pielke Sr., R.A., Human impacts on weather and climate (2Ed), Cambridge Univ Press, Canbridge CB2 8RU, UK, 2007
2. Lamb, D., Verlinde, J., Physics and Chemistry of Clouds, Cambridge Univ Press, Canbridge CB2 8RU, UK, 2011
3. Nitu, C, Krapivin, V.F., Soldatov, V.Y., Information technologies for the environmental investigations, Matrix Rom, Bucharest, 2013.
4. Seinfeld, J.H. and Pandis, S.N., Atmospheric Chemistry and Physics. From air pollution to climate change, John Willey and Sons Inc., USA, 2016
5. International Panel for Climate Change Reports – 6AR, 5AR, 4AR, TAR, SAR, FAR; 1992-2022; https://www.ipcc.ch/reports/
6. Bohren, C. Huffman, D.R, Absorption and scattering of light by small particles, John Wiley, N.Y, 1983
7. Kondratyev, K.Ya, Climatic effects of aerosols and clouds, John Mason Ed, Praxis Publishing Ltd., Chichester, UK, 1999
8. Peixoto, J.P, Oort, A.H, Physics of climate, Springer Verlag, NY, USA, 1992
9. Kuo, N.L. An introduction to atmospheric radiation (1st/2Ed), Elsevier Science, USA 2002.
10. Various web sites of dedicated research platform and scientific (original research or review) papers indicated by professor during the lectures.

7.3 Practicals	Teaching techniques	Observations
1a. Laws of black body radiation: obtaining the emission spectra of a black body at different temperatures using Planck's law / simulation the radiation emitted by a black body at different temperatures 1b. analysis of the distribution of the intensity of solar radiation scattered by constituents of the atmosphere that have different sizes: water drops of 10 um, 100 um considering the contribution of each process that determines the scattering (diffraction, primary internal reflection, secondary...) 1 c. analysis of the extinction efficiency versus the size of the radiation-scattering particle, depending on the refractive index of the particle	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	3 Hours
Determination of the possible daily duration of the Sun's lightning, of the effective duration of the Sun's lighting (insolation) and the insolation fraction. Deciphering heliograms.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	3 Hours
Measurement of global solar radiation, reflected radiation and diffuse radiation. Determination of the albedo of different surfaces. Determination of the net radiation at the earth's surface.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours
Determination, with dedicated software, of the direct spectral flux, of the diffuse spectral flux of solar radiation at different levels in the atmosphere, including the terrestrial surface. Further processing for the determination of the total flux, the net fluxes of diffuse radiation, the atmospheric turbidity factor. Study on the attenuation of global solar radiation due to clouds.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours
Determination of radiative forcing determined by radiatively active gases. Determination of the direct radiative forcing for an internal mixture and an external mixture of aerosol chemical species.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours
Determination, with dedicated software, of the optical parameters of different types of aerosol. Measurement of the total radiation scattering coefficient for aerosol with the nephelometer. Determination of the Ängström exponent.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	6 Hours

Solar photometry. The use of data from the AERONET network to study the atmospheric aerosol properties relevant to the radiative balance.	Guided practical activity: Experiment, Explanation, Conversation, Hypothesis testing	4 Hours

References:
References:
To the References' list of the course, the following is added:
1. ***Climate of Romania, Coordinators: Sandu I., Pescaru, V.I., Poiana, I., Geicu, A., Candea, I., Tastea, D., Ed. Romanian Academy, Bucharest, Romania, 2008
2. Schönwiese, C.D., Klimatologie, Eugen Ulmer Verlag, Stuttgart, 2013 4.
3. Scientific articles published in prestigious journals and specific interactive applications, either accessible via the internet, or usable stand-alone in the laboratory, together with explanatory notes/user manuals of the equipment used (available in the laboratory).

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- The clarity, coherence and the precision of the reasoning of an answer; - Correct use of concepts, laws, models, formulas and relationships; - The ability to exemplify.	Written exam and oral assessment	50%
Practical	- Completing laboratory assignments with an active attitude; - Knowledge and use of experimental techniques; - Good quality of the interpretation of the results.		50%
Minimal requirements for passing the exam	Attendance: attendance at a minimum of 50% of the number of course hours and mandatory attendance at all laboratory/seminar sessions.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Lect. dr. Gabriela Iorga	Lect. dr. Gabriela Iorga

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026

DO.205.2 Basics of energy audit/basics of environmental audit. Architectures and ecological houses

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Basics of energy audit/basics of environmental audit. Architectures and ecological houses
2.2. Teacher	Lector Dr. Sanda Voinea
2.3. Tutorials/Practicals instructor(s)	Lector Dr. Sanda Voinea

2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/2/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	0/28/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	35
Research in library, study of electronic resources, field research	17
Preparation for practicals/tutorials/projects/reports/homework	17
Tutorat	0
Other activities	0
3.7. Total hours of individual study	69
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	Mathematics, physics, chemistry intermediate level
4.2. competences	Usage of specific software packages for data analysis and processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Classroom supplied with a projector
5.2. for tutorials/practicals	Laboratory equipped for fundamental experiments; Computers and acquisition interfaces allowing computer-assisted experiments to be performed

6. Learning outcomes

Knowledge	R6. The student/graduate understands the mechanisms of pollutant transport and transformation, the sources and impact of plastic and radioactive materials, the functioning of green energy systems, as well as the methodological framework for environmental and energy audits. R9. The student/graduate knows the terminology specific to the field of environmental physics and ecological materials, for the purpose of effective communication in professional environments and towards society.
Skills	R6. The student/graduate can implement methods for analyzing the impact of pollutants and the life cycle of materials, understand the transport and transformation processes of substances in the environment, and systematically use audit techniques and strategies for sustainable resource and waste management. R9. The student/graduate can effectively communicate research results and proposed solutions, both in writing and orally, to diverse audiences, including colleagues, decision-makers, and the general public. Is able to synthesize information in a coherent and accessible manner.

Responsibility and autonomy	R6. The student/graduate has the ability to choose optimal solutions that offer the greatest benefit in a given context, developing and implementing strategies to reduce environmental impact, reporting audit results and substantiating decisions regarding energy and ecological sustainability. R9. The student/graduate has the ability to interact with key actors in the field of environmental physics and ecological materials, at the national and global level, disseminating results in the scientific community and publishing academic papers.

7. Contents

7.1 Lecture [chapters]	**Teaching techniques**	**Observations**
History of environmental protection; Environmental policy; Input-output analysis; Environmental aspects; Environmental aspects assessment; Legal requirements; Environmental management objectives, targets and programme. Documentation (documentation requirements, procedures, instructions and environmental management manual) .	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	8 Hours
Internal audit - definitions, audit criteria. Audit documentation -example, requirements for auditors, audit methods, role of audit in the management of the institution.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Case study for a concrete situation: drawing up an audit programme, checklist, audit plan, simulation - conducting the audit, drawing up the audit report.	Systematic exposition - lecture. Case studies. Examples. Conversations with students, seminar topics, homework, student involvement in problem solving.	4 Hours
Preliminary energy audit	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Functions and operation of the building. Climate data. Thermal comfort. Specific energy consumption. Energy calculations.	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	6 Hours
Building energy balance. Building envelope	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Energy performance of building installations	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours
Energy certification. Audit report	Systematic exposition - lecture. Heuristic conversation. Critical analysis. Examples	2 Hours

References:
Cristian Murica, Performanta energetica a cladirilor editia I partea II-a , Best Publishing, Bucuresti 2010. Cristian Murica, Performanta energetica a cladirilor editia I partea I-a , Best Publishing, Bucuresti 2009. Metodologia Mc001-PII.4 Renewable Energy, Ed. 3, Bent Sorensen, Elsevier Science, 2004 Advanced Materials Research Hun Guo, Zuo Dunwen, Tang Guoxing-Advanced Design and Manufacturing Technology I-Trans Tech Pubn , 2011 Advances in Intelligent and Soft Computing 127 R. Saravanan, P. Vivekananth, Tianbiao Zhang (eds.)-Instrumentation, Measurement, Circuits and Systems-Springer-Verlag Berlin Heidelberg, 2012 Leda Gerber-Designing Renewable Energy Systems_ A Life Cycle Assessment Approach-EPFL Press , 2015 Patrascu, S, Voinea, S, Fizica apelor subterane si de suprafata, Ed. Univ. Bucuresti, 1998. Seinfeld, J.H. and Pandis, S.N., Atmospheric Chemistry and Physics. From air pollution to climate change, John Willey and Sons Inc., USA, 2006. Tutu, H. (Ed.), Water Quality, Intech, 2017. Frank Duffy , Stamatina Th. Rassia, Panos M. Pardalos, Cities for Smart Environmental and Energy Futures Impacts on Architecture and Technology-Springer Berlin Heidelber, 2014

7.3 Practicals	Teaching techniques	Observations
Methodology for calculating the energy performance of buildings. Applications.	PC-directed work. Case studies. Examples	4 Hours
Energy performance certificate. Application for an apartment/house.	Supervised practical activity	4 Hours
The use of renewable energies to increase the energy performance of buildings. Exercises.	Supervised practical activity	4 Hours
Use of EnergyPlan and ReTScreen International calculation software. Applications.	PC-directed work. Case studies. Examples	4 Hours
Determination of optical parameters of different types of aerosol: urban, rural, marine, sea-salt. Determination of Angstrom exponent for different aerosol types.	Supervised practical activity	4 Hours
Determination and monitoring of pollutants in air, water and soil with UV-VIS spectrometry.	Supervised practical activity	4 Hours
Determination of CO, SO2, Nox gas concentrations using FTIR-gas spectrometry.	Supervised practical activity	2 Hours
Determination of volatile organic compounds (VOC).	Supervised practical activity	2 Hours

References:
Explanatory notes available in the laboratory / SERA website Calculation programs AERONET.gov website

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The discipline responds to the current national and international development and evolution of higher education in physics and energy sources. The curriculum of the subject is adapted to the level of knowledge and current requirements of scientific research and technological activities, and is correlated with similar curricula in European universities applying the Bologna system; In order to outline the contents and the choice of teaching/learning methods, the holders of the subject have consulted the contents of similar subjects taught at universities in the country and abroad (Technical University "Gheorghe Asachi" of Iasi, Polytechnic University of Bucharest, University of Brighton Department of Environment and Technology, Leibniz University Hanover). In the current context of technological development, the fields of activity targeted are multiple (environment, energy), with potential employers from the educational, administrative, industrial and R and D environments. Master's students are provided with skills appropriate to the needs of today's qualifications, a scientific and technical training appropriate to the Master's level, enabling them to enter the labour market quickly after graduation, and the possibility of continuing their studies through doctoral programmes; Masters students have the opportunity to actively participate in the development and implementation of new national energy and environmental policies.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- Ability to understand and correctly present the main experimental and theoretical results; - Ability to argue scientifically, ability to mathematically support the main results; - Ability to give relevant examples of the ideas presented; - Ability to draw significant practical consequences from theoretical results; - Ability to recognise important errors Ability to use theoretical knowledge in solving test problems	Oral examination in dialogue with the examiner. 40% Test solving specific problems chosen by the examiner (written exam) 30%	70%
Practical	Ability to use computer programs for various case studies; - Participation without exception in all laboratory sessions; - Interpretation of results and processing, resulting in a case study.	Evaluation by practical colloquium on the use of PC programs.	30%
Minimal requirements for passing the exam	Completion of all laboratory work and grade 5 in the colloquium. Participating to minimum 50% of the lectures and mark 5 at practicals verification.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Lector Dr. Sanda Voinea	Lector Dr. Sanda Voinea

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.210.1 Extreme phenomena. Meteorological and climatic risk

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Extreme phenomena. Meteorological and climatic risk						
2.2. Teacher	Prof. dr. Mihai Dima						
2.3. Tutorials/Practicals instructor(s)	Prof. dr. Mihai Dima						
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R2. The student/graduate knows the natural and anthropogenic factors that determine climate variability and change, methods for monitoring and modeling environmental parameters, as well as their effects on the environment and society.
Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R2. The student/graduate can critically analyze climate data to interpret the behavior of environmental systems, evaluating and interpreting parameters based on experimental and modeled data, estimating possible evolutions of the climate system.

Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R2. The student/graduate has the ability to plan and implement physical investigations on the environment, to interpret and use climate information in the decision-making process and to contribute to the development of solutions for adapting and mitigating the impact of climate change, effectively communicating the results within the scientific community and collaborating interdisciplinary.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Hazard and risk. Types of hazards: geologic, hydrologic, climatic and atmospheric	Systematic presentation. Examples	2 Hours
Extreme phenomena. Definition and observed manifestations	Systematic presentation. Examples	2 Hours
Abrupt climate changes. Definition and examples of past abrupt climate changes	Systematic presentation. Examples	2 Hours
Critical components of the climate sytem. Definition and examples	Systematic presentation. Examples	2 Hours
Arctic sea-ice, the ENSO phenomenon, the Indian monsoon, the Greenland ice-sheet, the West-Antarctic ice-sheet. Properties. Critical thresholds and the probability to reach them	Systematic presentation. Examples	2 Hours
Thermohaline circulation. Critical thresholds and the probability to reach them	Systematic presentation. Examples	6 Hours
Socio-economic implications of the risk phenomena Adaptation and resilience strategies of the human society	Systematic presentation. Examples	4 Hours

References:

IPCC reports, 2013, 2018, 2021.
Peixoto J and Oort K.,J., 1998: Physics of Climate, Ed New York, pp. 650.
Holton J. R., Hakim, G. J.,2013: An Introduction to Dynamics Meteorology, Academic Press, UK pp. 524.
Holton J., 1996: Introducere în dinamica atmosferei (traducere din l. engleză), Ed. Tehnica, Bucureşti, pp. 500.

7.3 Practicals	Teaching techniques	Observations
Visualizing data related to extreme phenomena using GRADS (Grid Analysis Data System).	Systematic presentation. Examples. Exercises	2 Hours
Processing data related to extreme phenomena using GRADS.	Systematic presentation. Examples. Exercises	2 Hours
Statistical methods for meteorological and climatic data analysis	Systematic presentation. Examples. Exercises	2 Hours
Methods to identify extreme phenomena	Systematic presentation. Examples. Exercises	2 Hours
Studying the response of the Atlantic Meridional Overturning Circulation to freshwater forcing in North Atlantic	Systematic presentation. Examples. Exercises	2 Hours

References:

GRADS user's manual: http://cola.gmu.edu/grads/
von Storch, H. and Zwiers, F.W., 1999: Statistical Analysis in Climate Research. Cambridge University Press, pp. 484.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

Before deciding about the content of the course, given the scientific and socio-economic significance of the topic, the tenured teaching staff have reviewed the content of similar courses taught in foreign universities. The content of the course is aligned with the requirements for teaching and research positions in various institutions

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- clarity and coherence of formulations - suitable use of models and analytic formulas - ability to provide examples	Written examination	70%
Practical	- Knowledge about using the GRADS application - Interpreting the results	Homework during the semester	30%
Minimal requirements for passing the exam	- Achieving a minimum grade of 5 in each exam. - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions. - At least 50% in each of the criteria that determine the final grade. Obtaining a grade of 10: - In addition to the criteria for obtaining a grade of 5: - Correct resolution of all subjects. - Skills and deeply well-argued knowledge.		

Date,
13.07.2025

Teacher's
name and signature,
Prof. dr. Mihai Dima

Practicals/Tutorials/Project instructor(s),
name and signature
Prof. dr. Mihai Dima

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DO.210.2 Physical processes in clouds

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Physical processes in clouds						
2.2. Teacher	Conf. dr. Bogdan Antonescu						
2.3. Tutorials/Practicals instructor(s)	Conf. dr. Bogdan Antonescu						
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	examen	2.7.Classification	DA

3. Total estimated time

3.1. Hours per week	3	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	0/1/0
3.4. Total hours per semester	30	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	0/10/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					48
Research in library, study of electronic resources, field research					24
Preparation for practicals/tutorials/projects/reports/homework					23
Tutorat					0
Other activities					0
3.7. Total hours of individual study					95
3.8. Total hours per semester					125
3.9. ECTS					5

4. Prerequisites (if necessary)

4.1. curriculum	Knowledge of Thermodynamics.
4.2. competences	Knowledge of using graphic representation programs, data processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R1. The student/graduate has in-depth knowledge of the principles of atmospheric physics, its structure and dynamics, as well as the exchanges of energy and matter in the climate system. R6. The student/graduate understands the mechanisms of pollutant transport and transformation, the sources and impact of plastic and radioactive materials, the functioning of green energy systems, as well as the methodological framework for environmental and energy audits.
Skills	R1. The student/graduate can analyze atmospheric processes using theoretical and instrumental methods, interpret weather maps and satellite data, and use climate and meteorological models to describe and forecast phenomena. R6. The student/graduate can implement methods for analyzing the impact of pollutants and the life cycle of materials, understand the transport and transformation processes of substances in the environment, and systematically use audit techniques and strategies for sustainable resource and waste management.

Responsibility and autonomy	R1. The student/graduate has the ability to plan and implement complex projects related to atmospheric phenomena, including research, forecasting, weather warning and climate policies, integrating knowledge in educational and professional contexts. He also disseminates the results in the scientific community. R6. The student/graduate has the ability to choose optimal solutions that offer the greatest benefit in a given context, developing and implementing strategies to reduce environmental impact, reporting audit results and substantiating decisions regarding energy and ecological sustainability.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Clouds	Systematic exposition - lecture. Examples.	2 Hours
Atmospheric thermodynamics	Systematic exposition - lecture. Examples.	2 Hours
Atmospheric dynamics	Systematic exposition - lecture. Examples.	2 Hours
Atmospheric convection. Condensation	Systematic exposition - lecture. Examples.	2 Hours
Stability and cloud formation	Systematic exposition - lecture. Examples.	2 Hours
Atmospheric aerosol. Precipitation formation. Kohler theory	Systematic exposition - lecture. Examples.	2 Hours
Microphysical processes in warm clouds	Systematic exposition - lecture. Examples.	2 Hours
Microphysical processes in cold clouds	Systematic exposition - lecture. Examples.	2 Hours
Precipitations. Thunderstorms and cloud dynamics	Systematic exposition - lecture. Examples.	2 Hours
Extratropical cyclones.	Systematic exposition - lecture. Examples.	2 Hours

References:

1. Ștefan, S., 2004: Fizica atmosferei, Vremea si Clima. Editura Universitatii din Bucuresti, 425 pg.
2. Lohmann, U., F. Lund, F. Mahrt, 2016: An Introduction to Clouds-From the Microscale to Climate. Cambridge University Press, 389 pg.
3. Rogers, R. R., M. K. Yau, 1996: A Short Course in Cloud Physics. Butterworth-Heinemann, 308 pg.
4. Houze, R. A., 2014: Cloud Dynamics. Academic Press, 432 pg.
5. Wang, P. K, 2013: Clouds and Precipitations, Cambridge University Press, 453 pg.
6. MacGorman, D.R. and W. D. Rust, 1998: The Electrical Nature of Storms. Oxford University Press, 422 pg.
7. Pruppacher, H.R. and J.D. Klett, 1996: Microphysics of Clouds and Precipitation. Springer, 980 pg.

7.3 Practicals	Teaching techniques	Observations
Analysis of stability and physical processes in clouds using SkewT diagram	Guided practical activity.	2 Hours
Clouds in satellite data	Guided practical activity.	2 Hours
Cloud properties using cloud radar data	Guided practical activity.	4 Hours
Representation of microphysical processes in numerical weather prediction models	Guided practical activity.	2 Hours

References:
1. Ștefan, S., 2004: Fizica atmosferei, Vremea si Clima. Editura Universitatii din Bucuresti, 425 pg.
2. Lohmann, U., F. Lund, F. Mahrt, 2016: An Introduction to Clouds-From the Microscale to Climate. Cambridge University Press, 389 pg.
3. Rogers, R. R., M. K. Yau, 1996: A Short Course in Cloud Physics. Butterworth-Heinemann, 308 pg.
4. Houze, R. A., 2014: Cloud Dynamics. Academic Press, 432 pg.
5. Wang, P. K, 2013: Clouds and Precipitations, Cambridge University Press, 453 pg.
6. MacGorman, D.R. and W. D. Rust, 1998: The Electrical Nature of Storms. Oxford University Press, 422 pg.
7. Pruppacher, H.R. and J.D. Klett, 1996: Microphysics of Clouds and Precipitation. Springer, 980 pg.

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Lecture	- The clarity, coherence and brevity of the exposition. - Correct use of calculation models, formulas and relationships. - The ability to exemplify.	Written exam.	50%
Practical	- Knowledge and use of the experimental techniques - Interpretation of the results.	Colloquium.	50%
Minimal requirements for passing the exam	Achieving a minimum grade of 5: - Attendance: presence at a minimum of 50% of the course hours and mandatory attendance at all laboratory sessions. - At least 50% in each of the criteria that determine the final grade. Obtaining a grade of 10: - In addition to the criteria for obtaining a grade of 5: - Correct resolution of all subjects. - Skills and deeply well-argued knowledge.		

Date,
13.07.2025

Teacher's
name and signature,
Conf. dr. Bogdan Antonescu

Practicals/Tutorials/Project instructor(s),
name and signature
Conf. dr. Bogdan Antonescu

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DFC.106 Volunteering

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Volunteering						
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic						
2.4 Year of study	1	2.5. Semester	1	2.6. Type of evaluation	verificare	2.7.Classification	DC

3. Total estimated time

3.1. Hours per week	0	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	0	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					0
Research in library, study of electronic resources, field research					0
Preparation for practicals/tutorials/projects/reports/homework					0
Tutorat					0
Other activities					25
3.7. Total hours of individual study					25
3.8. Total hours per semester					25
3.9. ECTS					1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Submission of a request (Annex 1 of the Regulation on Volunteer Credits within the University of Bucharest), addressed to the Dean and submitted to the Secretariat within 30 calendar days from the beginning of the semester. The host organization must be listed in the National NGO Register (www.just.ro/registrul-national-ong) or included in the list of validated host organizations at the Faculty of Physics.
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R11. The student/graduate knows the different contexts and opportunities for applying ideas in personal, social and professional activities, as well as how they can arise.
Skills	R11. The student/graduate demonstrates negotiation skills, empathy, assertive communication, leadership, teamwork, conflict and team management, as well as public speaking skills.
Responsibility and autonomy	R11. The student/graduate demonstrates initiative and self-control, has the capacity for anticipation and prospective evaluation, courage and perseverance in achieving personal and professional goals.

7. Contents

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Project	- Running the volunteer internship. - Volunteer activity recognition file	The volunteer's activity report, in written format -Annex 2 of the Regulation on volunteer credits from the University of Bucharest 50% Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity - Annex 3 of the Regulation on volunteer credits from the University of Bucharest 50%	100%
Minimal requirements for passing the exam	Existence of the volunteer's activity report and of the Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity. The assessment commission from the Faculty of Physics analyzes the mentioned documents and awards the grade Admitted/Rejected		

Date,
13.07.2025

Teacher's
name and signature,

Practicals/Tutorials/Project instructor(s),
name and signature
Conf. Dr. Cătălin Berlic

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DFC.111 Volunteering

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Volunteering
2.2. Teacher	
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic

2.4 Year of study	1	2.5. Semester	2	2.6. Type of evaluation	verificare	2.7.Classification	DC

3. Total estimated time

3.1. Hours per week	0	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	0	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/0/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	0
Research in library, study of electronic resources, field research	0
Preparation for practicals/tutorials/projects/reports/homework	0
Tutorat	0
Other activities	25
3.7. Total hours of individual study	25
3.8. Total hours per semester	25
3.9. ECTS	1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Submission of a request (Annex 1 of the Regulation on Volunteer Credits within the University of Bucharest), addressed to the Dean and submitted to the Secretariat within 30 calendar days from the beginning of the semester. The host organization must be listed in the National NGO Register (www.just.ro/registrul-national-ong) or included in the list of validated host organizations at the Faculty of Physics.
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R11. The student/graduate knows the different contexts and opportunities for applying ideas in personal, social and professional activities, as well as how they can arise.
Skills	R11. The student/graduate demonstrates negotiation skills, empathy, assertive communication, leadership, teamwork, conflict and team management, as well as public speaking skills.
Responsibility and autonomy	R11. The student/graduate demonstrates initiative and self-control, has the capacity for anticipation and prospective evaluation, courage and perseverance in achieving personal and professional goals.

7. Contents

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Project	- Running the volunteer internship. - Volunteer activity recognition file	The volunteer's activity report, in written format - Annex 2 of the Regulation on volunteer credits from the University of Bucharest. 50% Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity - Annex 3 of the Regulation on volunteer credits from the University of Bucharest. 50%	100%
Minimal requirements for passing the exam	Existence of the volunteer's activity report and of the Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity. The assessment commission from the Faculty of Physics analyzes the mentioned documents and awards the grade Admitted/Rejected.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025		Conf. Dr. Cătălin Berlic

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DFC.206 Volunteering

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title		Volunteering					
2.2. Teacher							
2.3. Tutorials/Practicals instructor(s)		Conf. Dr. Cătălin Berlic					
2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	verificare	2.7.Classification	DC

3. Total estimated time

3.1. Hours per week	0	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	0	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/0/0
Distribution of estimated time for study					
Learning by using one's own course notes, manuals, lecture notes, bibliography					0
Research in library, study of electronic resources, field research					0
Preparation for practicals/tutorials/projects/reports/homework					0
Tutorat					0
Other activities					25
3.7. Total hours of individual study					25
3.8. Total hours per semester					25
3.9. ECTS					1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Submission of a request (Annex 1 of the Regulation on Volunteer Credits within the University of Bucharest), addressed to the Dean and submitted to the Secretariat within 30 calendar days from the beginning of the semester. The host organization must be listed in the National NGO Register (www.just.ro/registrul-national-ong) or included in the list of validated host organizations at the Faculty of Physics.
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R11. The student/graduate knows the different contexts and opportunities for applying ideas in personal, social and professional activities, as well as how they can arise.
Skills	R11. The student/graduate demonstrates negotiation skills, empathy, assertive communication, leadership, teamwork, conflict and team management, as well as public speaking skills.
Responsibility and autonomy	R11. The student/graduate demonstrates initiative and self-control, has the capacity for anticipation and prospective evaluation, courage and perseverance in achieving personal and professional goals.

7. Contents

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Project	- Running the volunteer internship. - Volunteer activity recognition file	The volunteer's activity report, in written format - Annex 2 of the Regulation on volunteer credits from the University of Bucharest. 50% Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity - Annex 3 of the Regulation on volunteer credits from the University of Bucharest. 50%	100%
Minimal requirements for passing the exam	Existence of the volunteer's activity report and of the Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity. The assessment commission from the Faculty of Physics analyzes the mentioned documents and awards the grade Admitted/Rejected.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025		Conf. Dr. Cătălin Berlic

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DFC.207 Physico-chemistry of the environment

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Physico-chemistry of the environment
2.2. Teacher	Lect. dr. Gabriela Iorga
2.3. Tutorials/Practicals instructor(s)	Lect. dr. Gabriela Iorga

2.4 Year of study	2	2.5. Semester	1	2.6. Type of evaluation	colocviu	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	56	3.5. Lectures	28	3.6. Tutorials/Practicals/Projects	28/0/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	35
Research in library, study of electronic resources, field research	17
Preparation for practicals/tutorials/projects/reports/homework	17
Tutorat	0
Other activities	0
3.7. Total hours of individual study	69
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	Fluid Mechanics, Thermodynamics, Notions of mathematics, physics and chemistry
4.2. competences	Knowledge and practical capabilities of using the computer - Use of software packages for data analysis and processing

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment, white/black board and with internet connection, possibility of multiplying didactic materials in advance
5.2. for tutorials/practicals	Laboratory with modern equipment that allows performing fundamental experiments: samplers, meteorological station; Computers and acquisition interface enabling computer-aided experiments; Access to the equipment for air, water and soil sampling and to databases with environmental observations.

6. Learning outcomes

Knowledge	R2. The student/graduate knows the natural and anthropogenic factors that determine climate variability and change, methods for monitoring and modeling environmental parameters, as well as their effects on the environment and society. R3. The student/graduate knows the theoretical and practical concepts regarding the properties and functionalities of advanced materials (polymer materials, nanomaterials, hybrid composites or porous materials) for their application in environmental monitoring and remediation processes. R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy. R7. The student/graduate knows the principles of operation and use of measurement, analysis and testing equipment used in environmental physics and the characterization of ecological materials, including tools specific to environmental analysis.

Skills	R2. The student/graduate can critically analyze climate data to interpret the behavior of environmental systems, evaluating and interpreting parameters based on experimental and modeled data, estimating possible evolutions of the climate system. R3. The student/graduate can identify and analyze the characteristics of materials in relation to environmental applications, use characterization techniques and integrate these materials into sustainable technological solutions, conducting scientific research in the field of ecological materials with a focus on sustainability and reduced environmental impact. R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques. R7. The student/graduate can autonomously select and operate equipment and instruments appropriate to the investigated context, depending on the nature of the parameters and the level of precision required. Collects experimental data, operates equipment specific to scientific research and laboratory activities and performs laboratory tests.
Responsibility and autonomy	R2. The student/graduate has the ability to plan and implement physical investigations on the environment, to interpret and use climate information in the decision-making process and to contribute to the development of solutions for adapting and mitigating the impact of climate change, effectively communicating the results within the scientific community and collaborating interdisciplinary. R3. The student/graduate has the ability to plan and implement complex projects in the field of atmospheric and climatic phenomena, as well as sustainable materials designed to reduce environmental impact, effectively disseminating the results in the scientific community. R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics. R7. The student/graduate can choose the optimal working solution by critically comparing available alternatives, evaluating the technological and ecological impact in the short, medium and long term, to support sustainable and scientifically based decisions.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Introduction to environmental physico-chemistry. Definitions. Introductory notes about matter, substance, elements and chemical substances: fundamental laws in chemistry; atoms and chemical bonds; simple and complex substances, solutions and mixtures.	Lecture, description, explanation, conversation, debate	3 Hours
The environment and its components (atmosphere, geosphere, biosphere, hydrosphere, cryosphere). Definitions, structure, interactions, disturbances and their propagation, response to disturbances: response categories, response times, feedback processes. Elements of eco-nanotechnology, use of renewable resources.	Lecture, description, explanation, conversation, debate	4 Hours
Pollution sources, pollutants and types of pollutants. Classifications. Processes and reactions in which they are involved; redistribution and transfer of pollutants between the components of the environment.	Lecture, description, explanation, conversation, debate	4 Hours
Toxic pollutants. Elements of toxicity and persistence. Bioaccumulation, bio-magnification, biodegradability.	Lecture, description, explanation, conversation, debate	2 Hours

Water cycle in the environment. Water pollution. The impact of air pollution on water. Introduction to the physico-chemistry of underground and surface waters, drinking water, wastewater. Methods and techniques of measurement applied in the field of water pollution.	Lecture, description, explanation, conversation, debate	2 Hours
Pollutant transport in aquatic media. Inorganics: heavy metals. Nitrogen compounds, Phosphorus compounds. Organics: persistent organic pollutants (POPs), polycyclic aromatic hydrocarbons (PAHs), pesticide, Polychlorinated biphenyl (PCB), etc.	Lecture, description, explanation, conversation, debate	2 Hours
Effects of water pollution: eutrophication, hypoxia, water acidification. Water purification, filtration systems, decontamination and bioremediation of water. Measurement methods and techniques in the field of water pollution. The evolution of knowledge in the field of water pollution.	Lecture, description, explanation, conversation, debate	2 Hours
Air pollution - local, global and regional perspective. Gaseous pollutants (compounds with sulphur, nitrogen, carbon, non-methane hydrocarbons...) and pollutants in the form of particles (PM10, PM2.5, PM1). Heavy metal pollution. Tropospheric ozone. Physico-chemical properties that determine the biological effects of pollutants. Vertical distribution, dispersion and deposition of pollutants. Dry deposits and wet deposits - acid deposits. Legislation regarding ambient air quality on an international scale, in the European Union and in Romania. Methods and techniques of measurement applied in the field of air quality.	Lecture, description, explanation, conversation, debate	5 Hours
Soil pollution. The impact of air pollution on the soil. Physico-chemical characteristics of soils. Monitoring the physico-chemical properties of soils. Soil contamination. Bioremediation of soils polluted with heavy metals. Measurement methods and techniques. The evolution of knowledge in the field of soil pollution.	Lecture, description, explanation, conversation, debate	2 Hours
The principles of sustainable development, sustainability, circular economy. Green chemistry concept. International cooperation and scientific progress regarding research and reduction of environmental pollution and climate change. Reports of the Intergovernmental Panel on Climate Change (IPCC). Environmental pollution monitoring campaigns versus intensive measurement campaigns.	Lecture, description, explanation, conversation, debate	2 Hours

References:

1. Cheremisinoff, N., P., Handbook of air pollution prevention and control, Elsevier, MA, USA, 2002
2. Colls, J., Air pollution, 2nd Ed, Taylor § Francis e-Library, 2003.
3. Hernandez-Soriano, M.C.(Ed.), Environmental Risk Assessment of Soil Contamination, Intech, 2014.
4. Harrison, R.M., Understanding our Environment: An Introduction to Environmental Chemistry and Pollution (3rd Ed.), The Royal Society of Chemistry, Cambridge CB4 0WF, UK, 1999.
5. Iorga, G. ”Air pollution and environmental policies, EU and Romania: where we stand, what the data reveals, what should be done in the future?” , Book Chapter (23 pg) in Todor, A. and Helepciuc, F.E. (Eds.) ”Europeanization of Environmental Policies and their Limitations: Capacity Building”, Springer Nature Switzerland AG, Cham., ISBN 978-3-030-68585-0, https://doi.org/10.1007/978-3-030-68586-7_4, 2021
6. Jacobson, M. Z., Atmospheric pollution: history, science and regulation, Cambridge Univ. Press, Cambridge UK, 2002
7. Nitu, C, Krapivin, V.F., Soldatov, V.Y., Information technologies for the environmental investigations, Matrix Rom, Bucuresti, 2013.

7.2 Tutorials	Teaching techniques	Observations

The seminar topics follow the content of the course. The problems discussed aim at a deep understanding of the theoretical concepts presented in the lectures, the development of computational skills, and the proper use of the fundamental concepts of Physical Mechanics.	Presentation, conversation, exercises, case studies	28 Hours

References:
To the References' list of the course, the following is added:

1. Ibanez, J.G., Hernandez-Esparza, M., Doria-Serrano, C., Fregoso-Infante, A., Singh, M.M., Environmental Chemistry: Fundamentals, Springer, New York, NY, 2007, https://doi.org/10.1007/978-0-387-31435-8
2. Websites of Agencies Providing Methods and Guidelines Related to Environmental Monitoring: The U.S. Environmental Protection Agency (USEPA) USAWebsite: www.epa.gov/ The International Standards Organization (ISO) Switzerland Website: www.iso.ch/ The French Association for Normalization (FAN or AFN) France Website: www.afnor.fr/

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

In order to outline the contents, the choice of teaching/learning methods, given the particular importance of the discipline for applications using modern technology, the leader of the discipline consulted the content of similar disciplines taught at universities in the country and abroad. The content of the discipline is according to the requirements for employment in research institutes in atmospheric physics working groups and in education.

• The discipline meets the current requirements of development and evolution on a national and international level of higher education in the field of environmental sciences. The curriculum of the discipline is adapted to the level of knowledge and the current requirements of scientific research and technological activities, being correlated with similar study programs from European universities that apply the Bologna system. Master's students will have the necessary work skills to approach an interdisciplinary study in environmental sciences. The skills acquired by mastering the subjects covered in this course ensure an easier integration of graduates in mixed work groups. The master's students are provided with adequate competences with the needs of the current qualifications, a scientific and technical training corresponding to the master's level, which will allow them to be quickly inserted on the labor market after graduation (the fields of activity targeted are multiple, the possible employers being both from the educational area, research and development area, as well as from the industrial field, but also have the possibility of continuing studies through doctoral programs.

METHODOLOGICAL REMARKS • At each course session, the student will receive material containing schemes/diagrams, examples, stages of calculation procedures that will be explained in detail by the professor in his lecture. The interactive professor-student dialogue will represent the assurance that the students have clarified the concepts addressed. • For each topic addressed in the laboratory, the students will work as much as possible in groups of a maximum of two, under the direct guidance of the professor. The professor checks, interprets and discusses the results with each work subgroup separately, at the end of each work session. • The professor helps the students in preparing the material for the exam. Students can ask questions or discuss aspects addressed in the course or laboratory during the additional consultation hours, the schedule of which is made by mutual agreement between the professor and the student. • Attendance at lectures and practical activities is an essential condition for the good performance of the entire educational activity, so it is recommended to students to attend all classes. The material required for the exam will be presented, discussed in classes and laboratories/seminars. The wrong information about the discussions at the course/seminar/laboratory or the lack of it, the lack of materials necessary for the preparation for knowledge verifications and exams cannot be invoked by absence from the course. The listed references include at least all the subjects covered in the course and laboratory/seminar, for deepening some subjects according to the interest of each student. • Students' participation during the lectures is necessary because a dialogue helps them to better understand the concepts taught, to use an appropriate vocabulary, it creates the possibility of maintaining an interactive dialogue, as well as integration in the academic conduct. For an active presence in the course and laboratory, students are asked to review the material presented in the previous courses and laboratories. By participating in this course, the student agrees to accept the code of academic conduct presented in the University Charter, the Code of Ethics and the Regulation regarding the professional activity of students. The code prohibits students from copying and other forms of exam cheating, plagiarizing papers, presenting fraudulent documents and forging signatures.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- The clarity, coherence and the precision of the reasoning of an answer; - Correct use of concepts, laws, models, formulas and relationships; - The ability to exemplify;	Written examination	50%
Tutorial	- correct use of equations/mathematical methods/physical models and theories - ability to indicate/analyse specific examples	Continuos examination	50%
Minimal requirements for passing the exam	Attendance at a minimum of 50% of the number of courses and mandatory attendance at all seminars.		

Date,
13.07.2025

Teacher's
name and signature,
Lect. dr. Gabriela Iorga

Practicals/Tutorials/Project instructor(s),
name and signature
Lect. dr. Gabriela Iorga

Date of approval
15.07.2025

Head of department
name and signature
Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026

DFC.211 Simulation methods, modelling for renewable and alternative energy sources

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Simulation methods, modelling for renewable and alternative energy sources						
2.2. Teacher	Conf Dr. Cătălin Berlic						
2.3. Tutorials/Practicals instructor(s)	Conf Dr. Cătălin Berlic						
2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	0	2.7.Classification	DS

3. Total estimated time

3.1. Hours per week	4	3.2. Lectures	2	3.3. Tutorials/Practicals/Projects	2/0/0
3.4. Total hours per semester	40	3.5. Lectures	20	3.6. Tutorials/Practicals/Projects	20/0/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	43
Research in library, study of electronic resources, field research	21
Preparation for practicals/tutorials/projects/reports/homework	86
Tutorat	4
Other activities	-69
3.7. Total hours of individual study	85
3.8. Total hours per semester	125
3.9. ECTS	5

4. Prerequisites (if necessary)

4.1. curriculum	Notions of mathematics, physics at intermediate level
4.2. competences	Knowledge of using graphic representation programs, data processing.

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Room with multimedia equipment (Computer, video projector, internet connection); Course notes; Recommended bibliography
5.2. for tutorials/practicals	Computers and acquisition interfaces enabling computer-aided experiments;

6. Learning outcomes

Knowledge	R4. The student/graduate knows the theoretical models, numerical and statistical methods applied in modeling physico-chemical processes in the field of environmental physics, ecological materials and renewable energy.
Skills	R4. The student/graduate can develop and use computational models and statistical tools for the simulation, analysis and interpretation of complex phenomena in environmental physics, the field of ecological materials and environmental technologies. He also uses specialized numerical models for meteorological predictions and applies statistical analysis techniques.
Responsibility and autonomy	R4. The student/graduate has the ability to critically analyze specialized information and apply the knowledge acquired to develop and validate computational models, formulating rigorous scientific conclusions and substantiating decisions by interpreting data from processes specific to environmental physics.

7. Contents

7.1 Lecture [chapters]	Teaching techniques	Observations
Introduction to Multiphysics - introduction to modeling and simulation of physical phenomena	Systematic exposition - lecture. Examples.	2 Hours
AC/DC modeling - modeling of static components in electromagnetism.	Systematic exposition - lecture. Examples.	4 Hours
Acoustic modeling - Simulation of inductive and resistive sound damped in a model of a muffler	Systematic exposition - lecture. Examples.	4 Hours
Arduino microcontroller	Systematic exposition - lecture. Examples.	4 Hours
Heat transfer - basic modeling techniques for heat transfer using the heat transfer module.	Systematic exposition - lecture. Examples.	2 Hours
PDE modeling and simulation	Systematic exposition - lecture. Examples.	4 Hours

References:

1. S. Kumar, N. Gupta, S. Kumar, S. Upadhyay, "Renewable Energy Systems: Modeling, Optimization and Applications", Scrivener Publishing LLC., 2022
2. R.A. Messenger, A. Abtahi, "Photovoltaic Systems Engineering", CRC Press 2023
3. I. Dincer, C. Zamfirescu, "Sustainable Energy System Design and Modeling", Academic Press (Elsevier), 2020

7.2 Tutorials	Teaching techniques	Observations
Planar - parallel capacitors. Carrying out electrostatic analyzes of a capacitor and obtaining its capacity.	Presentation, conversation, exercises	2 Hours
Studying the acoustic pressure distribution of an ignition subwoofer - acoustic modeling in COMSOL.	Presentation, conversation, exercises	4 Hours
Simulation of damped inductive and resistive sound in a model of an exhaust.	Presentation, conversation, exercises	2 Hours
Using and programming of the ARDUINO microprocessors	Presentation, conversation, exercises	2 Hours
Biomaterial pills.	Presentation, conversation, exercises	2 Hours
Thermal disaggregation in a parallel plane reactor.	Presentation, conversation, exercises	2 Hours
Surface reactions in a micro-reactor.	Presentation, conversation, exercises	2 Hours
Optimization of a dipole antenna.	Presentation, conversation, exercises	2 Hours
Estimation of a thermal conductivity distribution at a given temperature profile.	Presentation, conversation, exercises	2 Hours

References:

1. B. V. Babu, R, Banerjee, "Energy Systems Modeling and Policy Analysis", C.R.C. Press 2024
2. Y. Kishita, "Applied Energy Simulation for Engineers and Scientists", Springer, 2022

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark

Lecture	- Knowledge of fundamental concepts in computer simulations of polymers; - Accurate acquisition and understanding of the topics covered in the course; - Demonstration of theoretical concepts using correct computational formulas; - Clarity, coherence, and conciseness of the presentation; - Correct use of the studied physical models, formulas, and computational relationships; - Ability to provide relevant examples; - Ability to apply acquired knowledge to solve practical problems.	Oral examination	60%
Practical	- Knowledge and correct use of specific experimental techniques - Data processing and analysis;	Oral examination	40%
Minimal requirements for passing the exam	Correct exposition of a theoretical subject. A minimum grade of 5 must be obtained in each component of the evaluation. Attendance: at least 50% of the course hours and mandatory attendance at all seminar sessions. At least 50% achievement in each of the criteria that determine the final grade.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025	Conf Dr. Cătălin Berlic	Conf Dr. Cătălin Berlic

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA

Syllabus

Academic year 2025/2026
DFC.212 Volunteering

1. Study program

1.1. University	University of Bucharest
1.2. Faculty	Faculty of Physics
1.3. Department	Matter Structure, Atmospheric and Earth Physics, Astrophysics
1.4. Field of study	Fizică/Physics
1.5. Course of study	Master
1.6. Study program	Enviromental Physics and Eco-Friendly Materials

2. Course unit

2.1. Course unit title	Volunteering
2.2. Teacher	
2.3. Tutorials/Practicals instructor(s)	Conf. Dr. Cătălin Berlic

2.4 Year of study	2	2.5. Semester	2	2.6. Type of evaluation	verificare	2.7.Classification	DC

3. Total estimated time

3.1. Hours per week	0	3.2. Lectures	0	3.3. Tutorials/Practicals/Projects	0/0/0
3.4. Total hours per semester	0	3.5. Lectures	0	3.6. Tutorials/Practicals/Projects	0/0/0

Distribution of estimated time for study	
Learning by using one's own course notes, manuals, lecture notes, bibliography	0
Research in library, study of electronic resources, field research	0
Preparation for practicals/tutorials/projects/reports/homework	0
Tutorat	0
Other activities	25
3.7. Total hours of individual study	25
3.8. Total hours per semester	25
3.9. ECTS	1

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competences	

5. Conditions/Infrastructure (if necessary)

5.1. for lecture	Submission of a request (Annex 1 of the Regulation on Volunteer Credits within the University of Bucharest), addressed to the Dean and submitted to the Secretariat within 30 calendar days from the beginning of the semester. The host organization must be listed in the National NGO Register (www.just.ro/registrul-national-ong) or included in the list of validated host organizations at the Faculty of Physics.
5.2. for tutorials/practicals	

6. Learning outcomes

Knowledge	R11. The student/graduate knows the different contexts and opportunities for applying ideas in personal, social and professional activities, as well as how they can arise.
Skills	R11. The student/graduate demonstrates negotiation skills, empathy, assertive communication, leadership, teamwork, conflict and team management, as well as public speaking skills.
Responsibility and autonomy	R11. The student/graduate demonstrates initiative and self-control, has the capacity for anticipation and prospective evaluation, courage and perseverance in achieving personal and professional goals.

7. Contents

8. Compatibility of the course unit contents with the expectations of the representatives of epistemic communities, professional associations and employers (in the field of the study program

The content of the subject is elaborated in accordance with the content of similar subjects taught at universities in the country and abroad. The content has been harmonized with the requirements imposed by employers in the field of industry, research, university and pre-university education of all degrees.

9. Assessment

Activity type	Assessment criteria	Assessment methods	Weight în final mark
Project	- Running the volunteer internship. - Volunteer activity recognition file	The volunteer's activity report, in written format - Annex 2 of the Regulation on volunteer credits from the University of Bucharest. 50% Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity - Annex 3 of the Regulation on volunteer credits from the University of Bucharest. 50%	100%
Minimal requirements for passing the exam	Existence of the volunteer's activity report and of the Certificate issued by the host organization showing the number of volunteering hours completed, as well as a brief evaluation of the volunteer's activity. The assessment commission from the Faculty of Physics analyzes the mentioned documents and awards the grade Admitted/Rejected.		

Date,	Teacher's name and signature,	Practicals/Tutorials/Project instructor(s), name and signature
13.07.2025		Conf. Dr. Cătălin Berlic

Date of approval	Head of department name and signature
15.07.2025	Lect. dr. Sanda VOINEA